SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

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CONTENTS:

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THE CARNEGIE INSTITUTION.

ONE of the cardinal difficulties which must, I take it, be met speedily by the administrators of the Carnegie Fund (and the present discussion may aid in showing what some of the difficulties are) is the problem how to divide its benefits fairly. For, according to the deed of the benefactor, the purpose of the gift is evidently to stimulate science in its widest acceptation, in all of its branches, applied, no less than theoretical. And to expend its goodly income on lines which will be in fullest keeping with the trust is by no means an easy task. Its trustees are bound to distribute its benefits fairly, but they may well be puzzled by the number and kinds of questions which require a practical answer. They have thus immediate opportunities for investment, which are legitimate, attractive, and which may never befall them again—*e. g.*, the acquisition of the Woods Hole station. They have also to deal with the importunate and well-deserving (colleges, societies, experimental stations, journals and individuals), some of whom, I fancy, are aggrieved at not having already received an annual sop from the Carnegie funds.

As a matter of fact, however, the Institution, in spite of its ten millions of dollars, is yet too poor to yield the immediate and miraculous draught of scientific results

which many of us expected. For science in these days has so many branches that the Carnegie funds will be able to increase —as far as funds can—the yearly scientific activity, as Professor Cattell estimates, by only about one per cent. There are, roughly speaking, about thirty main departments of scientific work, and computing the income of the Institution at $300,000, the share of each department could hardly equal $10,000 a year. Moreover there is the important question of expense of administration to be considered. Some have even suggested that a central organization be amply housed, and at considerable expense. But I for one fail to see that such an outlay would be for the greatest good of the scientific community. It would be rather a delectable than an all-important thing to have a well-built and splendidly equipped Carnegie headquarters in Washington, with a corps of high-salaried officials to give public lectures and to supervise select laboratories—at an expense of at least half the income of the institution. The main benefit in such a plan would, it seems to me, be too nearly local and individual to prove in best accord with the highest purposes of benefiting science. On the one hand the officials, chosen for eminence *after* they have done their major work, would, before many years, become quasi-pensioners, and unless they were removed ruthlessly, say by an age limit, they would soon cause the Institution to lose touch with recent developments and recent needs in science. And on another hand the Institution is not wealthy enough to run any risk of acquiring a political environment, or of evolving a highly specialized bureaucracy. And this risk is the less needful since the average investigator is apt to work for the benefit of the cause, unaffected by the stimulant possibility of some day being promoted to Washington with a salary of $10,000, to sit in a conspicuous chair, and perhaps as time goes on to have a gold-braided coat, frogged with gold acorns. Contrariwise, I feel strongly that the great purpose of the Institution would be best served if there were as little salaried officialdom as possible for the actual administration of its affairs. And I fancy that very few of the eminent scientists who are invited to become members of the committee, will refuse to act, and to act zealously and effectively, because they are not paid.

The fair-division problem of the trustees, then, narrows itself down to this: What branches of science are to be looked upon as equivalent candidates for benefits? And which ones are to be favored to the detriment of others? And for what reasons? Looking over a classified list of the 'sciences' one can readily select thirty branches, each of which, like electrical physics, or morphology, or organic chemistry, or psychology, or paleontology, would make the best of use of a Carnegie dividend. And a trustee would probably be embarrassed to have to pare down one of these branches for the benefit of the others. There is something to be said in favor of establishing a pro rata scheme of appropriations for the branches in accordance with a census of the number of worthy investigators which each branch includes. But, on the other hand, there are weighty reasons why such a plan would be inexpedient, since the number of workers may be out of proportion to the importance of their results, tested from the scientific standpoint. But here again is the difficulty of setting up an accurate standard of comparison. In any event there could be made a satisfactory division of science into approximately equivalent branches, say to the number of twenty-five or thirty, and for each of these an honorary committee be chosen. And the Institution, by the testimony of such expert committees, could be reasonably sure that its annual appropriations would find their

way where they would do a maximum of good. And each sub-committee could, it seems to me, best decide what share of its grant should be used for publication, individual grants, exploration, prizes for special themes of research, etc. So, too, to what degree a new or retarded division of its activities should be fostered to the detriment of an older and better equipped one.

In the matter of the character of work which it should be the general policy of the Institution, *i. e.*, in every branch, to provide for, I would suggest as most important: (1) publishing, (2) facilitating bibliographical work, (3) procuring material for research, (4) granting funds or fellowships. And the list could be readily increased.

1. *Publishing.*—One estimates conservatively, I believe, in affirming that *there are to-day enough worthy researches of American investigators to warrant the expenditure of the entire income of the Carnegie funds for purposes of suitable publication.* It has recently been suggested that American publications would be greatly aided by the establishing of a Carnegie bureau of engraving and printing which should execute at favorable rates the work of various societies. Such well-intended means, however, would bring with them certain practical drawbacks, and, judging from precedents, one would not be surprised if the output of the establishment became more costly and less efficient than that of skilfully directed private enterprise. More useful in practice, I fancy, would be direct grants for publication, say to periodicals of the stamp of the *American Journal of Morphology,* and permission of Congress for lithographic work to be brought through the customs free of duty when sanctioned by the Institution. The longer, more important, elaborately illustrated and carefully selected memoirs might appropriately be brought out by the Institution, and a splendid series of quarto and folio volumes would be a fitting fruit of our national work, to be to us in time what the *Philosophical Transactions* are to the British. And such publication I place among the very foremost needs of American science. We need hardly recall that for publication of zoological memoirs, to take an example, American authors have had either to accept the charity of foreign journals or to allow their researches to remain unprinted.

2. *Bibliography.*—All workers in science need skilful and energetic help in the thankless drudgery of reference hunting. To give them necessary aid the Institution should at once subsidize the Concilium Bibliographicum, an American enterprise, supported largely by the charity of Switzerland. The Concilium lacks only funds to enable it to extend its excellent work into various departments of biological science. Its work in zoology is invaluable. In connection with such a bureau it may be possible for the Institution to publish a series of bibliographical volumes (on the lines of the recent paleontological work of Dr. Hay) which will be a permanent boon to students in all branches of science. Another bibliographical development, in connection possibly with the Concilium, is a bureau to provide applicants with necessary literature lists; also a bureau in correspondence with libraries to place in the hands of investigators works of reference which cannot be procured by local means.

3. *Research Material.*—In some lines of research this can be secured only with considerable outlay. Thus for an important embryological study a sum of from five hundred to ten thousand dollars is not an uncommon expenditure. In this country such expense has usually been borne by generous outsiders or by investigators themselves; in rare cases universities or societies have contributed. In Europe,

however, societies have usually furnished appropriations, and in America, other calls permitting, the Carnegie Institution might justly follow their example. On the other hand, the maintenance of laboratories appears to me of less immediate value in encouraging research, for there now exist many and well-equipped laboratories in connection with university work throughout the country, open, too, on generous terms to any qualified investigator. The question of the Woods Hole station is, I think, exceptional, since nowhere else in the United States can marine investigations in all fields be carried on to similar advantage. Special experimental stations, however, for statistical and other variational studies are not as immediate a need since most of their work can be carried on in connection with the agricultural schools of many states. In this regard the history of foreign universities teaches us that research will flourish in spite of the lack of modern and splendidly equipped buildings. Men and books are at present less prevalent in our country than are tolerable quarters in which to house them. In no event would a Carnegie laboratory, I believe, be warranted in supporting classes for instruction as long as worthy investigators are in need of books, research material and means of publication.

4. *Grants and Fellowships.*—When the foregoing needs are suitably provided for the creation of fellowships would give very desirable means of stimulating activity in research. And in this matter one endorses heartily the suggestion of Professor Cattell in his recent paper in SCIENCE. None the less it is still a question whether, money being limited, more productive results would not follow the system employed by various trust funds of granting definite sums to deserving investigators to enable them to complete definite pieces of work.

COLUMBIA UNIVERSITY. BASHFORD DEAN.

MOST startling was President Harper's statement that Mr. Carnegie's gift of ten millions to it had injured Scottish education. Most disquieting was his view of the Carnegie Institution as a possible peril to science.

I venture to make public some brief hints of views as to how this great Carnegie Institution can contribute most effectively to the advancement of science. We speak of the endowment of research, but the real object is to bring to pass in the highest degree, to get started and carried to fruition, scientific creation, creative scientific achievement.

The payment for, the reward of, scientific productivity after it is over, is only a comparatively worthless parody of this supremely important aim. To have given Lord Rayleigh, already very wealthy, ten thousand dollars for having discovered argon was a pitiful waste of the money, almost painfully puerile.

Suppose the Fish Commission should spend its appropriation in pampering certain especially agile and powerful fish? What it did was to seek the point of danger, destruction and waste in the life-history, and in safeguarding these, make valuable its energies.

With the possible scientific creators also the loss is greatest just at the start.

Of those gifted with scientific genius, many allow that genius to atrophy, the potential never becomes actual; perhaps the scientific career is deliberately rejected in favor of money-making.

This choice of career is largely, almost instinctively, a matter of attractiveness and safety.

Such a spectacle as the ejectment of the Cincinnati professors, such a recurring spectacle as one of them passing through the streets and known to be unable, though highly worthy, to regain a foothold in the

on-go of paid science, strangles local scientific research unborn.

And if the keenest, brightest, most gifted of the young people reject the scientific career, then fellowships serve only a dull, stale, tired clique of incompetents.

Even after the possession of the rare and precious gift of scientific genius has been clearly, competitively proven, the possessor may choose what he considers a safer, more paying, more attractive career. I was twice Fellow of the Johns Hopkins University and among my contemporaries two, unsurpassed in gifts for scientific creativity, deliberately went over to money-making.

And finally among the sifted few who have the divine gift and the divine appreciation of their gift, the exquisite bud in its tender incipiency may be cruelly frosted.

Of the great Hilbert's 'betweenness' assumptions one was this year proved redundant by a young man under twenty working with me here, and by a demonstration so extraordinarily elegant and unexpected that letters from high authorities came congratulating the university on the achievement. Professor E. H. Moore, of the University of Chicago, has published his congratulatory letter spontaneously written (*Amer. Math. Monthly*, June–July, 1902, pp. 152, 153).

This young man of marvellous genius, of richest promise, I recommended for continuance in the department he adorned. He was displaced in favor of a local schoolmarm. Then I raised the money necessary to pay him, only five hundred dollars, and offered it to the President here. He would not accept it.

The Carnegie Institution is bound, I think, in order to promote most manifoldly scientific productivity, to consider such prenatal influences molding, making or unmaking the potential man of science.

As a practical application of such line of thought, this would favor the Woods Hole laboratory retaining its independent position and popular organization.

Men of science should never voluntarily take away from men of science the highest and finally responsible direction of scientific productivity.

The bane of the state university is that its regents are the appointees of a politician.

If he were even limited by the rule that half of them must be academic graduates, there would be some safety against the prostitution of a university, the broadest of human institutions, to politics and sectionalism, the meanest provincialism.

Just so scientific journals should be absolutely controlled by scientific men, independently or in connection with scientific societies.

So the purchase by the Carnegie Institution of the *American Journal of Morphology* would appear ill-advised. The paramount aim should be to help, not to dominate.

Everything in a completely subsidized journal is taken at a discount. Judicious, delicate, sympathetic *help* for every developing scientific mind, for every wise scientific enterprise, should be the watchword.

Science is remodelling the life and thought of the world. Mere acquirement must give place to active production.

The spring is spontaneity. With this the Carnegie Institution must never interfere. Original work has ever been largely connected with teaching.

We have reached the position that, to be of the highest quality, teaching must come from a creator. What of the inverse? Is teaching a benefit to productivity? This is a vital question for the Carnegie Institution.

Sylvester held that the two functions s..ould never be divorced.

I believe it is largely on this point that President Harper thinks the Carnegie Institution a peril.

But the great scientific work of our government has been dissociated from teaching, and on the other hand some of our well-known institutions of learning are dragging far behind the times.

For example, it seems to me that a school of science which requires Latin could not properly be given a general subsidy.

Mathematics, that general instrument and servant of all the sciences, would be chiefly helped just now by translating the results of the experts into form comprehensibile to all men of science.

The mass of mathematics published in analytic and symbolic form, in hieroglyphics, is disheartening, is almost stupefying, while the great results, though capable of elegant, interesting and easy presentation, remain unknown even to men of science.

For example, of geometry Hilbert says: 'The most suggestive and notable achievement of the last century in this field is the discovery of non-Euclidean geometry.'

Then should not every man of science know what it is and what it has settled?

George Bruce Halsted.

Austin, Texas.

In answer to a request of the editor of Science we would suggest that a primary and natural function of the Carnegie Institution would be 'to lend a helping hand' to investigators already at work in our colleges, universities and scientific societies. This need for aid in research is more pressing than the foundation of numerous scholarships for unfledged or immature students, except for the few who have already shown a remarkable capacity for original work.

The president and trustees of the Carnegie Institution, so far as they have yet gone, have acted wisely in appointing committees of scientific men to consider the claims for aid already received, and this seems to be the primary and most important as well as natural course to pursue.

The tendency in this country, not only in national and state governments, but also in municipal governments, as also perhaps in the management of our public libraries, is towards a marked disproportion between the cost of maintenance, and the amount, in the case of libraries, for example, devoted to the purchase of books.

It is to be hoped that at present at least the income of the Carnegie Institution will not in very large part be devoted to buildings and laboratories to be erected in Washington, but be given directly to the promotion of researches in physical and natural science now being planned or carried on by officers of existing institutions, by members of scientific societies and other investigators.

We would venture to suggest, as doubtless others have, that a fair proportion of the income should be expended in appropriations or grants, such as are made by the British and the French Associations for the Advancement of Science on such a considerable scale, and in a smaller way by the National Academy of Sciences of the United States and by the American Association for the Advancement of Science, through funds given or bequeathed by the friends of science for the furtherance of scientific investigations.

This has been effected by committees, who have and are gratuitously doing their work with care, faithfulness and discrimination.

The applications for aid in research received by the trustees of these funds from

investigators in this and other countries are already, in some cases at least, more numerous than can possibly be granted, and if we mistake not their number is annually increasing.

It seems scarcely necessary to make very exhaustive search for the exceptional genius, for already there are hundreds of investigators of fair training and ability who are more or less hampered for want of time and means to carry on and complete original work already begun.

While in physical science work has to be carried on in fixed, permanent, elaborately and expensively equipped laboratories the case is somewhat different in the natural sciences. The geologist, paleontologist and biologist need to make collections, to travel, to work in marine or fresh-water laboratories, and in laboratories for experimental evolution studies. Hence funds are needed for traveling expenses, for preparing and setting up specimens, for artists, assistants in breeding and making other experiments, for microscopic apparatus, for aid in preparing bibliographies, and in making translations of articles and memoirs in foreign languages not generally taught or studied, as Russian, etc. Finally the Carnegie Institution might lend its aid in publishing, with suitable illustrations, the results of such investigations.

These are the lines along which it appears to us this noble benefaction will accomplish the greatest results.

From the writer's point of view the pressing needs in pure, unapplied biology, and for which pecuniary help is urgently required, are the following: Further researches in the life-histories of the lowest organisms, in the growth and metamorphoses of insects, crustacea, molluscs and of the lower vertebrates, in temperature experiments in the line of the splendid researches of Dallinger, Weismann, Standfuss, Merrifield, Dixey and others, who have wellnigh demonstrated the actual process of species, variety and race-making; in extended researches on the problems of variation, heredity, telegony, phylogeny and zoogeography. To carry out such researches as these we need much larger grants than any which have yet been possible.

To further and carry on such investigations, there is not yet needed an elaborate corps of officials and workers localized at Washington, whose climate is unfavorable for research nearly a third of the year, but the appointments of trustees or committees who shall make the grants, leaving to the investigators in all parts of this or any other country the opportunity of carrying on original scientific work.

A. S. PACKARD.

I READ with much interest the article on the above subject in SCIENCE of September 19. I agree with many of Professor Cattell's views, but I feel very strongly that the keynote of the activity of the Institution should be, in the words of the founder, 'To discover the exceptional man in every department of study whenever and wherever found, inside or outside of schools, and enable him to make the work for which he seems specially designed his life work.'

Whenever the directors depart from this wise policy it seems to me the step will be a backward one. The best way in my opinion to stimulate research is not to endow or build laboratories or institutions of any kind, but to endow competent men. Not elaborate apparatus is the prime necessity, but the mind to understand what is seen. The fall of an apple may suggest to a Newton a great generalization, but he needs the time and the opportunity to think and work out the law in his own way.

My idea is that men seeking endowment for research should present their

plans to the scientific society or college to which they belong, and that, on approval of the society or college, the plan of research be submitted to the trustees of the Carnegie Institution and, if approved by the trustees, a grant of money be made to be spent in any way needed by the investigator himself and at his own discretion. He can judge better than any one else how the money can be spent to advantage. The only requirement should be that he should give a detailed account of the expenditure at stated intervals, and these accounts should be open to public inspection. It may be found, however, that the most competent investigators will object to disclosing plans which they may not be able to execute and also object to the attitude of beggars.

A second plan would be for the trustees of the Carnegie fund to send statements to certain well-known colleges and scientific societies, and say that certain funds are available for research in certain departments of science, furnish us the best available man who is willing to do this work. Then give that man perfect freedom as to the how and why within the limits of the funds available for the special purpose. This would be similar to scholarship endowment which Professor Cattell recommends, except that I would not make it contingent on the attainment of any given college degree unless it be some special degree based on success in original work. Unfortunately a college degree is not a test of capacity for research. Huxley is reported to have said that he would have been floored by a civil service examination, and Darwin was not considered a brilliant student at school. The brilliant work of Faraday would have been lost to the Royal Institution if its support had only been given to doctors of philosophy.

If neither of these plans is considered feasible or sufficient, then I think the endowed laboratory, observatory or institution in each department of science should be of very moderate cost and be considered merely the workshop of the investigator. This plan might be found the most feasible way of obtaining investigators because it would suggest permanency of work and arouse pride in the institution; but I wish to urge that in all cases the institution should be considered only an appendage to the investigator, and no great amount of money should be absorbed in its construction. As Dewar pointed out in his recent address before the British Association for the Advancement of Science the remarkable work of the Royal Institution of London has been carried on at a very small cost.

Henry Helm Clayton.

Professor Cattell's article in a previous number of Science contains many admirable suggestions as to what the Carnegie Institution might do for the advancement of science, especially where he shows the need of a fund to pay the expenses of the cooperation of this country in international undertakings of scientific character, and of more substantial aid to individual investigators than the small prizes and fellowships that are granted at present by learned societies and universities. But he seems to take for granted that the Carnegie Institution will confine itself to what is called 'science' in a narrow sense, to the exclusion of the humanities and of applications of science. This can hardly be the intention of the founder of the Institution and of its trustees. The other branches of knowledge, especially the humanities, are certainly as important for the welfare of man and as worthy of support as pure science, while they have infinitely less resources in the way of endowment of research. It seems to me that if the trustees of the Carnegie Institution intend to

give substantial and permanent aid to research in all directions, they cannot accomplish this better in any other way than by instituting bibliographical research and publication on a large scale. By endowing a Bibliographical Institute along the lines suggested by the present writer in an article in SCIENCE for October 18, 1901, and in an address before the American Library Association this summer, printed in their 'Papers and Proceedings,'* the trustees would in fact endow all scientific and literary research.

The bibliographical question needs a thorough solution if it shall be possible for future students and investigators to keep informed of what has been written in their lines of study. The 'International Catalogue of Scientific Literature' solves the problem for pure science only, leaving out altogether both the applied sciences and the humanities, and it does not at all touch the literature of past centuries. It is particularly unfortunate that the immense literature of the nineteenth century has been allowed so long to remain an unorganized mass. Here, it seems to me, is the greatest opportunity for the Carnegie Institution. The cost would not exceed fifty thousand dollars a year.

An entirely new institution is needed to take care of the bibliographical interests of the new century, as none of the agencies that have attempted to systematize it so far, in this country at least, will be likely to cover the field in a way that would satisfy scientific research. I may mention four such agencies, first among them the office of the *Publishers' Weekly*, from where a series of trade bibliographies have issued for more than twenty-five years. Mr. Bowker has certainly systematized this work in a very efficient way, but his office being a business house, he must of course see that his undertakings are put on a paying basis (and bibliographical work of scientific nature can hardly ever be put on such a basis), and, furthermore, the work of his office is almost exclusively restricted to trade bibliography. The Publishing Board of the American Library Association has for years with very limited means, seconded, it is true, in a very remarkable way by Mr. George Iles, and with the partial cooperation of certain libraries, carried on effective cataloguing, indexing, and even bibliographical work, in aid of our public libraries; now, with the interest of the Carnegie endowment, the board will extend its work, but undoubtedly keep on in the lines already laid out. The interests of the Smithsonian Institution in bibliography is merely incidental, and although it has shown not a little activity in this field, it has with few exceptions stuck to the field of chemical bibliography (besides Pillings's bibliographies of Indian languages). The most hopeful agency for scientific bibliography at present is the Library of Congress, which, especially through the printed cards prepared by the catalogue division, will do excellent service to bibliography; its division of bibliography seems at present to be more or less restricted by the duties of the library to Congress, but will undoubtedly as the years go on develop its very interesting work of indexing the resources of the library more fully and more minutely than the catalogue division; but it is doubtful whether it will be able to, or even ought to go outside of the library's own collections. At least, it has been the experience of some libraries who have tried to do more extended researches in the bibliographical field, that by doing so they have encroached upon the time and the forces that were expected to be utilized in the immediate interest of those who were using the libraries. We need a separate institution, devoted exclusively to purely bibliographical work,

* See *Library Journal*, July, 1902.

and there would be no better opportunity for the Carnegie Institution to serve the whole field of science and scholarship than by establishing such an institute.

Aksel G. S. Josephson.

The National and State Governments are now devoting considerable amounts of money annually to scientific investigations, the results of which promise to be of direct and immediate economic value. Such investigations have been so far successful that it is now comparatively easy to secure liberal appropriations of public funds for such purposes. In our colleges and universities, the professors and their assistants are individually devoting themselves more and more to original research and are being encouraged to do this by boards of management. The funds at the disposal of these investigators are as yet comparatively limited and their amount depends very largely on the personal activity of the investigator, but there is nevertheless good reason to believe that in the future it will grow easier for such individual investigators to secure the financial backing they need to make their own investigations successful. And it seems desirable that our institutions for higher education should make the support of such research a part of their regular business, and should seek endowment for it in the same way that they seek funds to maintain their courses of instruction.

Leaving out of account, then, economic investigations supported by public funds and such relatively limited researches as can be conducted by individuals connected with colleges and universities, there remains a class of large and fundamental investigations which require special endowment. With the development of science in modern times it is clear that many fundamental problems cannot be satisfactorily studied except by the cooperation of scientists trained in different lines, the use of complicated and costly apparatus, and investigations conducted for a long time and on a large scale. Take, for example, the fundamental problems in biology regarding the origin of life, or the principles underlying the breeding and nutrition of animals. Our agricultural experiment stations can easily secure funds for breeding and feeding experiments which seem likely to promise results of immediate practical value, and they are now engaged in making numerous such experiments, but it has been difficult for them to devote even a small portion of their funds to the more fundamental studies of breeding and nutrition. Wherever they have ventured to attempt these, the work has as a rule been on too small a scale to give the best results. Instead of the few hundred dollars spent annually in such researches, it should be thousands of dollars; instead of experiments with a few subjects, there should be experiments with a considerable number of subjects in order that general rather than special conclusions may be drawn from the work.

For example, the most elaborate investigations on the nutrition of man yet conducted are those of Atwater with a respiration calorimeter, in which a single subject was studied during periods of three to twelve days. While the results of these investigations have been valuable, they are from the nature of the case not thoroughly satisfactory. Not only should the apparatus and methods for such investigations be further improved, but there should be opportunity for carrying them on with a number of calorimeters at the same time and for longer periods. This would necessitate the expenditure of relatively large sums of money in this kind of research, but it would be money well spent, for there would be a much larger chance of securing some definite and final results than present conditions of research in that line afford.

As regards the breeding of animals, almost all the work thus far done by the experiment stations has been empirical in character. There is at present no satisfactory manual on the breeding of animals written from a scientific standpoint, and I am informed that the data for such a treatise are not available. To make a thorough study of the science of animal breeding would require the maintenance of considerable numbers of animals and studies continuing over many years.

I have cited nutrition and animal breeding as among the subjects on which elaborate and costly scientific investigations are needed, because I happen to be somewhat familiar with the nature of investigations in these lines. There are of course many other lines in which similar investigations are equally needed.

From what I have said it is plain that, as regards the Carnegie Institution, I am in favor of the expenditure of its income in relatively large blocks for the maintenance of elaborate investigations on a limited number of fundamental problems of science, and especially those fundamental problems on the solution of which largely depends the improvement of the conditions of human life, industry and society.

A. C. TRUE.

IT would be presumptuous for any one to suppose that he has solved the difficult problem that is before the trustees of the Carnegie Institution. They are to be commended for the free expression of opinion they have invited, and doubtless the policy they adopt will represent a fair resultant of the varying competent opinions of American men of science. In any discussion of a general policy one cannot deal with details except by way of illustration, and illustrations are taken most naturally from one's own department of work.

I have taken for granted that the purpose of the Carnegie fund is to increase the opportunities for scientific research, so that the results may be more commensurate with the number and ability of investigators. This means that it is to supplement the efforts made by existing institutions, which in the main are the government scientific bureaus and the universities. To duplicate what these institutions are already equipped to do would seem to be a waste of this particular fund. There is probably no diversity of opinion in reference to this proposition, and the real problem is to discover wise methods of supplementing the opportunities for research.

My own constant thought has been that no single costly enterprise should be undertaken at first which might pledge permanently a large amount of the income, and might prove presently to be either unprofitable or too narrow. For example, the expenditure involved in the purchase and development of the Marine Biological Laboratory at Woods Hole would certainly lock up all the funds available for biology, and this would be a narrow view to take of the opportunities needed for biological research. Speaking for my own subject, fundamental as are the problems that must be investigated in a marine laboratory, there are botanical investigations of equal importance that must be made over the general surface of the country. It has seemed to me, therefore, that the first experiment to be conducted by means of the Carnegie fund is to discover how it may be expended so as to yield the largest results. As laboratory students we know that no amount of discussion will result in this discovery, but that trials must be made before 'the trail is struck.' This means the absence of any detailed and rigid policy at present, but one of such great flexibility that retreat is possible at every point.

To make this endowment perennially

effective and free to be applied as the needs of scientific research develop, it would seem wise to stimulate every worthy enterprise to self-support as rapidly as possible, and to help it no longer than it needs help to be effective. I am sure that a good deal that is undertaken can be gradually unloaded upon universities, state and national governments, or even upon other private endowments, leaving the Carnegie fund free to turn to the new fields that need cultivation.

In my own mind there are at least three categories in which the needs of increased opportunities for scientific research may fall, and these suggest methods of supplementing the opportunities offered by existing establishments. Other departments of work may have different needs, but I am speaking under the pressure of the needs of my own subject.

1. There are competent investigators, whose ability is well known, who need in the main more leisure for work, and in some cases perhaps more equipment. Anything that will meet this need is sure of results. Just how these investigators can be selected, and how their needs may be met without any relaxation of effort on the part of the institutions to which they belong are matters of detail. From such men no outline of work or promise of results can be exacted, for it is the unexpected that often leads to their most important discoveries. Perhaps in this same general category may be placed the needs of those who give promise of becoming competent investigators, but to whom lack of means has denied the opportunity for advanced training. This opens up the whole question of fellowships, and it may be urged that this is the business of the universities. It is a notorious fact, however, that not one-fourth of the promising candidates that apply for fellowships can obtain them.

2. There are well-defined general problems that need a corps of investigators to collect data, which no existing institution is likely to provide for. Speaking in the largest sense, competent and prolonged biological surveys of various kinds, over various areas, are sadly needed to reduce our loose empirical statements to definite statements of facts. Such work can be definitely outlined in scope and purpose, and the results are assured.

3. Students of botany have no greater need at present than a good station in the American tropics, where tropical material and conditions are available. The highest and most varied expression of plant life is found in the rainy tropics, and the laboratories of temperate regions are only on the border-land of their subject. To establish such a laboratory and to make it possible in the way of transportation for competent investigators to visit it when their problems demand would be one of the greatest opportunities that could be offered to American botany. The important results that have been obtained in the Dutch station at Buitenzorg, Java, visited by comparatively few investigators, prove what an American station, near at hand and inexpensive to reach, would do for botany. It is probable that in the establishment of government stations in the tropics for practical purposes such cooperation could be arranged that the only need would be a modest equipment and reduced transportation.

Even if such a general outline were adopted, the most effective selection and methods would have to be discovered through trial.

Of course, in all sciences facilities for starting new work would be desirable, but the greatest present need in botany is to make it possible to do in a better way and upon a larger scale what we already have in hand.

John M. Coulter.

Hull Botanical Laboratory,
The University of Chicago.

*THE BRITISH ASSOCIATION. A RETROSPECT.**

THE third Belfast meeting, in respect of attendance, has been very considerably below the average, the numbers being a little over 1,600, or about 300 less than in the case of the previous meeting, 28 years ago. This falling off is mainly due, we believe, to the fact that the people of the neighborhood did not take an active interest in the meeting by becoming associates to anything like the extent that might have been expected. The number of old life members and old annual members, as well as of new life members and new annual subscribers from a distance, was not below that of the previous Belfast meeting and was up to a fair average. There may be other reasons to account for the diminished attendance. Although the Saturday excursions were numerous and attractive enough, and the garden parties and other receptions of daily recurrence, still there were no official excursions following the meeting. It is to be hoped that these will never be revived. There is no reason to regret the falling off, if it is mainly due to the fact that the attractions to unscientific trippers were fewer than in the past. It is true that the diminished attendance led to the cutting down of the grants for scientific research to an unusually low figure; but, after all, there are nowadays many other ways of obtaining pecuniary support for such purposes. The afternoon receptions especially have a serious effect on the attendance of such sections as meet after lunch. This practice of holding afternoon meetings is likely to spread among the sections, and it is deserving of consideration whether some modification should not be made in what is, after all, no necessary part of the functions of the Association.

At Belfast, as at previous meetings, probably some of the most useful work of the Association was done outside the section rooms, at the informal gatherings that take place among the working members. A staple subject of discussion at such meetings is that of the functions of the Association in relation to modern conditions so very different from those which existed even half a century ago. The scientific work of the Belfast meeting was certainly up to the average in most of the sections, although in many cases the papers read were of restricted and very special interest. The new section which deals with education, as well as the section of economics, set a good example by arranging beforehand to have only a very few subjects of wide interest on their programs, to be dealt with on the four or five real working days of the meeting, and to be thoroughly discussed by men capable of treating the subjects with knowledge and intelligence. It would be well if the other sections would follow this admirable example. It would give the British Association much more of a *raison d'être* than it has at present, all the more if it could also be arranged that two or more sections should combine for the consideration of important subjects in which they have a common interest. It is also felt that one important object of these meetings should be to bring the younger workers in the different departments of science into personal relations with those who have already made their reputations and who, by a few kindly words of encouragement and guidance, might do much to inspire the younger men with confidence and enthusiasm. At present the younger workers in science, who come from all parts to attend these meetings, as well as those who may be working at serious disadvantage in the locality, may spend the whole week diligently attending the meetings of the sections and never exchange a word with their distinguished seniors. The large receptions that are held during the meet-

* From the London *Times*.

ings are of little avail for this purpose; but there are other and more informal ways which it would not be difficult to devise.

These are some of the topics which were freely discussed at the informal gatherings of the permanent members of the Association, most of them men of distinction in the scientific world. It must be admitted that the chilly and rainy weather which prevailed during most of the week may have had no inconsiderable effect upon the attendance. It must be said, however, that the hospitality of Belfast was thoroughly Irish in its warmth; and, as has been stated, the scientific work of the meeting was quite up to the average, on the lines on which that work is at present conducted. In most of the sections one or two subjects of considerable importance were brought forward for consideration and discussion, although, as we have said, Sections F and L carried off the palm in this direction. The attendance at the Educational Section was always large; the Anthropological Section was often crowded; while the section of geography, although unfortunately located at a considerable distance from the center, had no reason to complain of being neglected. Although the proposal that the meeting of 1905 should be held in Cape Colony was mentioned at the general meeting, the matter was not discussed. The serious consideration of the proposal will no doubt take place next year, when probably the invitation will be brought forward formally. It is to be hoped that nothing in the meantime will occur to place the matter in abeyance.

We shall now give a brief résumé of what may be regarded as the most important results of the meeting. The address of the president, Professor Dewar, will be of permanent value as a history of the efforts which, up to the present, have been made to investigate the effects of extreme low temperatures upon gases.

In a review of the work of Section A (Mathematical and Physical Science), two of the subjects dealt with stand out prominently. Professor Schuster, chairman of the department of astronomy and cosmical physics, called attention to the great waste of power which is taking place in sciences like meteorology, where those working at the subject are devoting their energies almost exclusively to the collection of observations. Those engaged in reducing the observations, and in deducing from them the physical laws which underlie meteorological phenomena, are few. As a result, undigested figures are being accumulated to an extent which threatens to crush future generations. Professor Schuster pointed out that observations taken without a view to the solution of some definite problem were of comparatively little value, and pleaded that a larger proportion of the time at present devoted to the collection of observations should be given up to their discussion. This, he thought, should be done even at the expense of discontinuing observations which, like those of the magnetic elements at Kew, have been carried on for many years without a break. In the discussion of these suggestions that followed, Dr. Shaw, head of the Meteorological Office, pointed out that many of the proposed changes could best be carried out by the establishment in one or more of our universities of professorships of meteorology. Such a course would lead in a few years to the existence of a body of trained meteorologists capable of discussing, from a physical point of view, the observations taken by the organizations at present at work. The other prominent question which has been referred to was brought forward by Lord Rayleigh, who asked, Does motion through the ether cause double refraction of light in transparent bodies? He reviewed the evidence which has led physicists to conclude that the earth in its

motion does not drag the ether along with it. Thus each body on the earth's surface is, in virtue of its motion with the earth, traversed by a stream of ether, and the question arises—Does light travel through such a body with the same speed along the stream of ether as it does against or across it? The experiments of Michelson and Morley lead to an affirmative answer for air; those carried out recently by Lord Rayleigh now enable the same answer to be given in respect of liquids; and it is hoped they will soon decide the question in the case of solids.

In Section B (Chemistry) considerable interest was taken in the discussion of two monographs on hydro-aromatic compounds with single nucleus (Dr. A. W. Crossley) and our present knowledge of aromatic diazo-compounds (Dr. G. F. Morgan). The subject of the first of these contributions derives interest from the fact that hydro-aromatic compounds form a starting-point in the study of the camphors and the constituents of turpentines and many essential oils. The diazo-compounds are important, not only because their study has led to theoretical results of the utmost value in connection with the mechanism of chemical change, but because they are used industrially in the manufacture of most of the coal-tar dyes. The two monographs referred to are to be published at length in the annual report. They constitute very complete résumés of branches of organic chemistry, of which the literature is distributed through many different journals. If for no other reason than this, they will prove of great service to both teachers and students of the two subjects. The paper on the alkylation of sugars, by Professor T. Purdie and Dr. J. C. Irvine, deserves special notice; the method which it described for exchanging hydroxilic hydrogen atoms in the molecules of certain sugars by methyl groups should prove of great value. Dr. E. F. Armstrong contributed an important paper on the synthetical action of enzymes, in which the formation of a disaccharide by the action of the enzyme lactase on milk sugar was described. The new disaccharide, isolactose, is a true sugar and its synthesis is one of the first steps taken in synthetic work upon disaccharides.

No one of the papers brought before Section C (Geology) was of very great importance; but nearly all were records of valuable work. A paper by Mr. George Barrow, on the prolongation of the Highland border rocks into county Tyrone, gave rise to the best discussion of the meeting. The paper dealt with rocks termed the 'green rocks,' found by the author in the neighborhood of the great fault which crosses Scotland from sea to sea. This line of disturbance has now been traced across Ireland to Clew Bay and Clare Island, and Mr. Barrow believes that he can identify rocks in the neighborhood of Omagh with the 'green rocks' of Scotland. He considers them to be of pre-Cambrian age, and with this conclusion Professor Grenville Cole agrees. Papers of considerable importance were read by Dr. Traquair and Mr. H. Kynaston. The former described some fossil fishes of the lower Devonian roofing-slate of Gmünden, in Germany. They belong to the class with mailed bodies, and the fact that they are there found associated with fossils of a thoroughly marine character shows that these mailed fishes lived in the sea. Mr. Kynaston, who has been mapping the northern part of Argyllshire for the Geological Survey, brought forward satisfactory evidence proving that the sheets of volcanic rocks in the neighborhood of Glencoe and the Black Mount are, like the volcanic series of Lorn, of lower old red sandstone age, and that the great granite mass of Ben Cruachan is of newer date than these volcanic sheets. This was probably the most important paper brought before

the section. The rocks of Eocene age attracted more attention from the members in the field than in the section room. They were dealt with at some length by Professor Grenville Cole in his lecture on the geology of the neighborhood of Belfast, and Mr. Horace B. Woodward contributed a valuable note, describing a section on the new railway between Axminster and Lyme Regis. The Pleistocene and recent periods received a large share of the attention of the section. Mr. Teall, director of the Geological Survey, exhibited a late proof of a new drift map of the Dublin area, which will be the first sheet of the Geological Survey map on the scale of one inch to the mile, printed in colors, instead of, as has hitherto been the custom, colored by hand. It is to be hoped that more of these color-printed sheets will be issued, as they are both cheaper and clearer than the hand-colored maps. The post-glacial deposits of the Belfast districts were dealt with in an interesting paper by Mr. Lloyd Praeger. He described the 'peat bed,' an old land surface now twenty feet below low-water mark at Belfast, but between tide marks at other places. In it the Irish elk has been found.

In Section D (Zoology), as in the other sections, no startling or epoch-making discoveries were brought to light; but most of the papers were quite equal to the average of former years in interest and importance, and were solid contributions to zoological science. In his opening address the president, Professor Howes, traced in a masterly summary the marvelous advances made since the last Belfast meeting in our knowledge of the animal kingdom and in the precision given to our ideas of the interrelationships of its various groups, thanks to the morphological method. Of great practical importance were the papers by Professor McIntosh and Mr. Garstang on the international scheme for the protection and increase of the North Sea fisheries. Considerable divergence of opinion existed as regards the over-fishing of certain parts of the North Sea. Professor McIntosh held that it was practically impossible to overfish; but this is not the view of Mr. Garstang nor of the majority of marine biologists. The committee which is investigating the migration of various British birds this year presented an interesting summary, by Mr. Eagle Clarke, of Edinburgh, of observations on the migrations of the fieldfare and lapwing. This was drawn up in the same masterly manner as his previous reports on the migrations of the song-thrush, white wagtail, skylark and swallow. It is certain that, if we are ever to fathom the mystery of migration, it will be only by the methods employed by Mr. Clarke. The zoological collections obtained by Professor Herdman among the pearl-oyster beds in the Gulf of Manaar were described by various specialists; and in this connection it must be remarked that to the ordinary naturalist it does seem that some restraint is called for in the description of new species, especially among some of our amateur workers. Upon minute differences in characters subject to great variation numbers of unique specimens have been added to an already overburdened literature, many of which can be only individual variations. Professor Poulton's exhibition of a series of the predaceous flies of the family Asilidæ, taken in Spain, was specially interesting. Each was shown with its prey in its grasp. The prey consisted mainly of bees and ants, but extended to bugs and beetles, often several times the size of the assailant. The females, which are larger than the males, apparently also prey upon the males of their own or a nearly related species. Very interesting, too, among several interesting contributions on the subject of mimicry, were Professor Poulton's slides, prepared by the three-

color process, showing the protective resemblance and seasonal forms of butterflies, and the natural attitudes of British insects. There is an undoubted tendency on the part of insects, and also of many other animals, not only to adopt the color tone of their immediate surroundings, but also to imitate the appearance of other insects so as to escape the dangers threatening their own species. Professor Poulton lucidly explained how the phenomena exemplified by the slides can best be interpreted by the theory of natural selection. Professor McBride and Dr. Masterman summarized the results of their investigations, extending over several years, of the development of the starfish. But on several important points the two authors appear to have arrived at opposite conclusions, and further investigation is evidently needed. Professor Ewart continued the interesting contributions he has made to this section on the subject of the inter-crossing of animals, with an account of his experiments on dogs. His main contention was that in the second generation a purer offspring was obtained than in the first; but the general opinion was that this conclusion was scarcely warranted after so limited a number of experiments.

The address of the president, Sir Thomas Holdich, in Section E (Geography) ought to be of great service in this department, insisting as it did on the necessity for the introduction of more scientific methods in geographical work, and especially in the work of exploration, which may now be said to have passed beyond its pioneer stage. Mr. R. B. Buckley, in his paper on 'Colonization and Immigration in British East Africa,' gave an excellent example of the practical uses to which geographical investigation may be put, if only conducted on rigidly scientific lines; while Professor Libbey, in the account which he gave—admirably illustrated as it was by photographs taken with intelligence and discrimination—of his recent work in the Jordan Valley, showed the instructive results which may be achieved by the scientific method applied to pure geographical investigation. Other examples pointing in the same direction were the papers of Dr. Herbertson on the windings of the Evenlode; Mr. Lloyd Praeger on geographical plant groups in the Irish flora; Mr. Porter on the Cork Valleys; and especially that of Professor Watts on a buried Triassic landscape, Charnwood Forest. Professor Milne's brilliant account of his investigations into world-shaking earthquakes showed the perfection to which his seismological records have attained, and the important discoveries which he has thus been able to make as to the part played by these disturbances in altering, not only the face of the dry land, but also the bed of the ocean. As might have been expected, the subject of Antarctic exploration formed a prominent feature in the meetings of this section. Nothing could have been more admirable than Dr. Mill's exposition of the various stages of our knowledge of the South Polar region and of the actual results of exploration up to the present time; while Mr. Bruce, the leader of the Scottish Antarctic Expedition, had a hearty and thoroughly sympathetic reception when he came forward to explain the objects and equipment of that expedition, which, as distinguished from others now at work in the Antarctic, will be mainly oceanographical. The communication from Sir Clements Markham, with reference to a possible search expedition for Captain Sverdrup, was highly instructive—though, happily, now that Captain Sverdrup has arrived home, no such expedition will be required. Dr. Johnston's account of the Survey of the Scottish Lakes, which is being conducted under the direction of Sir John Murray, showed what a vast amount of ex-

cellent work has been accomplished in considerably less than a year's time.

By regular attendants at Section F (Economical Science) the Belfast meeting will be remembered chiefly for its president's address and for the large and attentive audience which followed the papers of local interest. Dr. Cannan in his address struck the keynote of the meeting—the reinforcement of the most elementary economic principles and their immediate application to the complex problems now to the fore in popular discussion. The meeting did not elucidate any important new contributions to economic theory, but appeared to be educative in its character. Again and again professed economists emphasized, apparently to the complete satisfaction of a well-filled room, the teaching of the most orthodox masters in refutation of badly-conceived proposals. It would be untrue to say that Dr. Cannan's simple and conclusive application of the theory of rent to the question of municipal housing and other municipal ventures commanded the immediate and unqualified approval of a section which has been in the habit of debating municipal policy year by year with the accredited representatives of local governing bodies through the length and breadth of the land. When Mr. Porter, on the Friday, condemned unhesitatingly all productive municipal enterprises, speakers from Nottingham and Manchester were in disagreement with his conclusions; but the general audience appeared to be in sympathy with the reader, and the discussion was not sufficiently long or representative to cover the ground adequately. Those who agree with the reader of one of the weakest papers ever presented to the section, that a large body of educated thinkers are weakening on the strict theory of free trade, should have been present on the day devoted to Irish questions. The representatives of Belfast industries were completely at one with the platform in denying the practicability of an Imperial Zollverein, as emphatically as they ridiculed the proposal for a 'moderate measure of protection for Ireland.' The advantage to the home-country of a differential duty in its favor on the part of a colony was generally admitted; but the question whether such a relaxation was to the real interest of the colony was not discussed. Judge Shaw's paper, which introduced and dominated the discussion, was deservedly applauded; for it put in a simple, accurate, and intelligible form, calculated to appeal to the ordinary educated man, the fallacies and difficulties inherent in current protective proposals. The plan, introduced at former meetings, of allotting a day to those subjects which are of special interest to the locality was continued and expanded. The 'free trade' day began with a valuable historical essay on the linen trade; and, to judge from the local press, this was calculated to be of considerable use to those engaged in the industry, as well as of importance to the statistical historian. A previous morning had been devoted to the consideration of trusts, with particular reference to the shipping combination. Though this excited much local interest, it cannot be said that the audience was really representative, nor that much was added to the theory or the facts in question; but, so far as it went, the tone was optimistic. Belfast does not stand to lose by recent developments; it was expected that the British shipping interest would survive without damage; and, on the more general question, it was held that trusts did not flourish in a free-trade atmosphere, and that, even where their existence could be maintained, prices would not rise nor wages fall; but there was a lamentable absence of reasoned statistical verification. Education was to the fore in Section F, as well as elsewhere; and, in the presence of

teachers from Dublin, Belfast, St. Andrews, Edinburgh, Oxford, Cambridge and London, a discussion as to the possibilities and future of commercial education had to be closured when the luncheon hour was far passed. As is always the case, the few papers which were of definite value for the clearing up of disputed points in theory attracted little attention. Among these were Professor Morison's demonstration that the prices of cereals measured in silver in India had fluctuated at least as much as English gold prices through the nineteenth century, and Professor Chapman's careful analysis of the possibilities and use of sliding scales and other means of regulating wages in relation to profits and of minimizing their fluctuations. There were very few statistical papers. The practical work of the section is for the present concentrated in the investigation, which now enters on its third year, of its committee on the 'Economic Effect of Legislation Regulating Women's Labor.' A long interim report was presented, and two careful papers were contributed on the recent history of administration. It seems probable that the committee will accumulate a large amount of first-hand evidence; and it is so constituted that all phases of opinion are represented. On the whole, the section shows signs of renewed vitality; the platform and the room were generally well-filled, the discussions were well sustained, though not informing, and the communications showed careful and well-reasoned work.

The subjects which occupied most of the time of the Section G (Engineering) were 'education' and 'power.' The president, Professor John Perry, professor of mechanics in the Science School at South Kensington, has actively demanded for some years past that the methods of teaching young engineers should be improved. Mathematics has been the point on which he has been most urgent; and a committee was appointed, with Professor Forsyth as chairman, on his initiative, to consider how mathematics can be better taught. This year the address from the presidential chair dealt with the subject of an engineer's education more generally, and insisted particularly on the continual use of experiment by the student himself as distinguished from oral lecture or demonstration by the professor. Professor Perry's address was subsequently made the subject of discussion at a joint meeting of the Engineering and Educational sections, under the presidency of Professor Armstrong, in which several well-known scientific men and engineers took part. In a highly suggestive paper in this section Mr. W. Taylor raised the question of what he termed 'the science of the work-shop.' It is the application of scientific knowledge of the properties of matter to work-shop processes, and the examination of the many curious and important problems raised by them. Instruction in this branch of science is necessary for the mechanical engineer and the artisan, in just the same way that mathematics and dynamics are for the civil engineer or the electrician. The questions which have to be dealt with are in many cases minute and abstruse, information on them is scarce, and they do not form part of any generally useful educational subject. It is evident, however, that accurate knowledge on such subjects as the properties of cutting tools, of lubrication, of the thermal treatment of steel, and the numberless other processes carried on in our workshops, too often only by rule of thumb, is of first-rate importance to mechanical industries. In the subject of power important papers were read on gas-engines, on the combustion of coal, and on the standing question of water-tube boilers. Most of the considerations were of a highly technical kind; but two broad facts were clearly brought out—viz.,

the rapid development that is taking place in the use of gas-engines for very large powers, and the advantages possessed by the water-tube boilers over the tank boilers, which justify perseverance in trying to remedy their present defects. The Hon. C. A. Parsons attracted a large audience to hear a paper on the recent progress of the steam turbine. Besides the above subjects, a very able and judicial paper on the difficult question of competition in telephony was contributed by Mr. J. E. Kingsbury, which deserves to be widely read both on account of the author's intimate knowledge of the subject and of the calm temper of his review. He concluded that the telephone service was essentially not a proper field for competition. An account by Professor George Forbes of the practical trials in the South African war of his beautiful range-finder excited great interest.

So far as Anthropology (Section H) is concerned, the Belfast meeting will rank as one of the most efficient for some years past. The average quality of the communications was high, and the tone of the discussions uniformly business-like and judicial. The president's address, which was devoted to the much-debated question of the nature and origin of 'totemistic' observances among uncivilized peoples, certainly contributed much, by its cautious and learned survey of the evidence, to clear a somewhat thorny field; and its suggestion that many if not all of these customs may be primarily related to the all-important subject of the food supply of primitive man will probably be found to have suggested a profitable field of fresh inquiry. With this encouragement from the chair, it is not surprising that the other papers on points of custom and folklore were numerous and of good quality; the most important of them, Mr. Hartland's discussion of the modes of appointment of Kings by augury, being further made appropriate to the season by its examination of the significance of the Stone of Destiny at Tara and our own Coronation-stone. Archeological papers were numerous. Some of those of local origin were perhaps hardly up to the general level, but gave indication of intelligent and systematic work on the antiquities of the neighborhood. Mr. Abercromby's classification, on the other hand, of the earliest pottery of the Bronze Age in these islands, and Mr. Coffey's identification of objects in Ireland analogous to those of 'Hallstatt' and 'La Tène' style on the continent, were pieces of original research of a high order, and each provoked a well-sustained discussion. The Cretan Report brought up to date the record of Mr. Evans's discoveries at Knossos; and other papers on Mediterranean archeology, though not so numerous as of late, showed that efficient work is being carried on by other students also. The Cretan Exploration Committee was reappointed, with enlarged terms of reference and a fresh grant; and it has instructions to make the examination of the physical type of the ancient and more recent population one of the objects of the forthcoming campaign. The discussions which arose on paleolithic matters, though, as usual, not very conclusive, raised a number of interesting points, and were well illustrated from the collections of Mr. W. J. Knowles and other contributors; and two little reports, on Roman sites at Silchester and at Gellygaer, near Cardiff, showed that the Association regards even 'classical' archeology as lying on the margin of its domain. Papers reporting recent explorations abroad were fewer than usual, South Africa claiming still the majority of the men of adventure. But Mr. Henry's paper on the tribes of the Yun-nan border showed well what opportunities frontier officers have about them, if they will use them; and its description of the new pygmy folks

there offered an instructive parallel even in detail to the legends of the 'little people' in the west of Europe. Messrs. Annandale and Robinson added considerably to the materials collected in the Malay Peninsula by the Skeat expedition of two years ago; and the account which Dr. Furness gave of his work among the Nagas showed well to what extent photography can now be applied in recording these vanishing aborigines. The committees appointed to prosecute research on the sense perception of the Todas and on the surviving languages and peoples of the Pacific illustrate still further the urgent necessity of gathering in such material before it is too late. Human anatomy and physical anthropology were somewhat better represented than in recent years; but it is much to be regretted that this side of the section's work is not better attended on both sides of the table. Professor Cunningham's exhibit of the skeleton of Cornelius MacGrath, the Irish giant, raised an interesting point in the study of abnormal stature, by connecting it with abnormal states of the pituitary body in the brain; and Professor Dixon, who followed him, was able to support his view on independent grounds. The reports of the measurements taken by Dr. Myers of the native troops in Egypt, and by Mr. Gray of the Indian Coronation contingent, showed well how much might easily be done, with very small trouble, with large bodies of individuals accustomed to obey simple instructions. In Egypt, indeed, the Government offered every facility for the investigation; but at Hampton Court, as well as at the Alexandra Palace, the European officers hardly seem to have taken the inquiry seriously, and displayed a regrettable indifference to a matter in which, after all, they are themselves the most nearly concerned. The last session, devoted to questions of classification, organization and method, was well worth imitation elsewhere; and suggests that the anthropologists are becoming well alive to the necessity of coordination and systematic outlook in their work.

Although the meetings of Section I (Physiology) were confined to the forenoons of three days, the proceedings were enlivened by a number of contributions of undoubted physiological value. Professor Halliburton's presidential address, which emphasized the importance of chemical physiology, did not prevent experimental and morphological contributions from receiving their share of attention and criticism. The opening day witnessed a discussion following a paper by Dr. Edridge-Green on color-vision. Dr. Edridge-Green has a theory of his own on this subject which he has brought forward with great persistence and under various titles before physiological circles for some years back. This time he supported his theory by describing some experiments the results of which are at variance with those recorded by previous observers. He was then and there challenged by Professor McKendrick to repeat his experiments before a committee of experts. The challenge was accepted by Dr. Edridge-Green, whose theory has therefore every prospect of being soon put to the test. Professor Schäfer's two contributions were of exceptional value. In one he showed that the epithelial part of the pituitary body, which preponderates over the nervous part and to which no function has hitherto been assigned, in reality elaborates an internal secretion which acts powerfully on the kidney, producing increased urinary flow. In his second communication he added an important chapter to the physiology of those puzzling strands of nerve fibers in the spinal cord known as the anterior columns, assigning to them the maintenance of tone in the muscles, without which volitional movement would be impossible. Equally important, as new

and unlooked-for discoveries, are those cases in which problems long the subject of debate and contention are solved or dismissed. If finality is ever attainable in physiological debates the question of fatigue in nerve has surely reached that stage; for Professor Gotch showed by the results of his ingeniously simple but convincing experiments that functional fatigue does not exist in a medullated nerve. Much the same may be said of the paper by Professor Halliburton and Dr. Mott, in which strong evidence was brought forward in support of the contention that when a divided nerve grows again and heals the growth takes place from that end which is connected with the nerve center. Dr. John Turner's paper on the human brain was both morphological and physiological. Professor Schäfer accepted as accurate the morphological part, but dissented from Dr. Turner's physiological interpretations. It will be seen, even from this succinct sketch, that the Physiological Section enjoyed a successful, if brief, career, and that physiology has been enriched by contributions of importance.

In his presidential address to Section K (Botany) Professor J. R. Green emphasized the study of vegetable physiology, not merely on account of its intrinsic importance in special botanical problems, but as a subject of fundamental economic importance, especially in relation to agriculture. The papers read in this branch of the subject were of considerable interest, one of the most important being that by Professor Bose, who showed by experiments that plant tissues respond to stimulation in much the same way that muscle fiber does. Mrs. D. H. Scott also described the curious movements of the flowers of *Sparmannia* in relation to its environment. Professor Macfadyen described experiments on the exposure of bacteria to intense cold, which demonstrate that their vitality is not destroyed even after an exposure to a temperature of 250° C. below zero. In the department of fossil plants great interest was shown in the papers contributed by Mr. Seward, Miss Benson, D.Sc., and Mr. Lomax; and Dr. Scott submitted observations on Sporangiphores, which indicate that they may afford an important clue to affinities among groups of recent and fossil plants. One of the important papers was that by Professor Oliver and Miss Chick on *Torreya,* which raised many points of morphological importance, especially in connection with the evolution of the seed. Mr. Stirling, in a paper on the flora of the Australian Alps, pointed out that the evidence now available confirms the original forecast of Sir J. D. Hooker, that the affinity between the Antarctic and South African floras indicates them as members of one great vegetation. Some valuable papers on fungi were contributed from the Cambridge botanical laboratory, and Miss Lorrain-Smith read a paper of economic importance on a fungus disease of the gooseberry. Mr. Lloyd Praeger contributed a valuable paper on the composition of the flora of the northeast of Ireland. The arrangements made by the local secretaries were excellent; and interesting excursions to the new fernery at the Botanic Gardens and to Colin Glen were well attended by the botanists present at the meeting.

In the second year of its existence the infant section of the Association—L (Education).—has justified the efforts of those primarily responsible for its appointment by the extraordinary interest that has been evinced in its proceedings. The papers and discussions have reached a high level, and have given a stimulus to educational thought which has already borne valuable fruit and provided many constructive suggestions. The section is naturally exposed to the grave danger of becoming the happy hunting ground of educational faddists.

But the committee have from the first realized this danger, and in order to avoid it have adopted a procedure somewhat different from that of other sections; broad subjects of discussion have been laid down by the committee, and those papers arranged for that form valuable contributions to such discussions. It is thus possible to obtain the succinct opinions of a considerable number of educationists without occupying the time of the meetings with the elaboration of formal papers. On few other platforms can educational problems be discussed from so thoroughly independent and scientific a point of view by men representative of all types of culture and imbued with the spirit of progress. The section should in the future play an important part in directing public opinion towards a solution of the numerous problems of British education. The selection of Professor H. E. Armstrong as president of the section was but a fit and proper recognition, not only of his efforts in establishing the section, but of his persistent and unwearying advocacy of reform in the methods and ideals of English education. In his discourse on 'The Scientific use of the Imagination' he showed in eloquent and forcible language that the long domination of the schools by the classic and the cleric has led to a serious disuse of the imagination in education. Time-honored curricula in the public schools have retained their autocratic influence, in spite of the fact that in the meantime science has revolutionized every sphere of industrial and social activity; he laid down a doctrine of education and an ideal of the function of the school which are far removed from those at present accepted by the great body of schoolmasters.

If there is one paper more than another that will make the Belfast meeting of the Association remembered, it is that of Dr. Starkie, the Resident Commissioner of national education. Occupying the principal official educational appointment in Ireland, he ruthlessly laid bare the insidious causes that have stunted the development of education in that country. The vast majority of Irish schools are controlled by one manager—the minister of religion of the denomination to which the school is attached—who has absolute power over the appointment and dismissal of the teacher, but who provides no part of the teacher's salary; the department of national education pays the full salary of every teacher, and has no voice whatever in appointing or dismissing him. As there is no local taxation for primary education in Ireland, except for those few schools vested in, and therefore maintained by, the commissioners, there is no satisfactory means of keeping the school buildings in a habitable condition, or of supplying the necessary equipment. The funds the manager can raise seldom stray from the path to the church, and the upkeep of the school is too often chargeable to the underpaid teacher. The courageous attitude of the Resident Commissioner has already profoundly stirred educational thought in Ireland, and, it is to be hoped, has aroused a public opinion on the subject which it is indispensable should be created before an attempt can be made to find a remedy. The partial reforms that have recently been made in intermediate education in Ireland were condemned by Mr. Jones and Father Murphy on account of their incomplete and unsatisfactory character; and the discussion which arose on this subject must have an important influence on future policy. The new Department of Agriculture and Technical Instruction, for which Mr. Plunkett has labored so long and so earnestly, met with almost unqualified approval as to its educational policy.

It will be remembered that Professor Perry's vigorous onslaught upon the mathe-

matical teachers last year resulted in the appointment of a very strong committee to inquire into the matter. The report of this committee and the discussion upon it amply justified Professor Perry's action. Both professor and schoolmaster came forward to advocate reforms in secondary schools suggested in the report; definite constructive proposals have been made as to the curriculum and conduct of examinations; and, though it is obvious that reform cannot stop at this stage, a valuable step in the right direction has been taken. 'The Teaching of English,' which the great public schools, accepting the traditional classical curriculum, have seriously neglected, received considerable attention. Mr. P. J. Hartog, in an able paper, drew attention to the method of teaching style in composition adopted in the principal French schools, and urged that the classical master is wrong in assuming that the only method of teaching English composition and style must be through the medium of Greek and Latin, of which languages the average school boy has not obtained a real grasp. The training of teachers is, undoubtedly, the problem of paramount importance in educational affairs to-day, and the debate on this subject was valuable in directing attention to the shortcomings of existing arrangements for training. Miss Walter's plea for a secondary school career for the future teachers of primary schools is one admitted by every one dealing with primary schools.

SCIENTIFIC BOOKS.

EHRLICH'S SEITENKETTENTHEORIE.

THE recently published work of Professor Aschoff (Ehrlich's 'Seitenkettentheorie und ihre Anfwendung auf die Künstlichen Immunisierungsprozesse') will be of great use to those who desire to keep abreast with the progress of science in this fruitful field of investigation. It is, indeed, an intelligent review of the whole subject of acquired immunity, and includes a statement of the principal facts which have been developed by experiment, as well as a discussion of the various theories which have been advanced in explanation of these facts. The great interest attached to the subject and the extent of the field of investigation which has been developed since the epoch-making discovery of the antitoxins of diphtheria and of tetanus by Behring and Kitasato (1890) are shown by the extent of the literature given by Aschoff at the close of his review ('Zusammenfassende Darstellung'). This covers 41 pages and includes nearly 900 titles. Of these Ehrlich has contributed no less than 22. His first paper, published in 1891, demonstrated the remarkable fact that animals can be made immune against certain vegetable poisons (ricin and abrin), and that the blood serum of such animals contains an antitoxin which has a specific action in neutralizing the toxic effects of these poisons, when injected into non-immune and susceptible animals. In prosecuting his investigations Ehrlich has had the advantage over many others who have devoted themselves to similar researches in the fact that he is a most accomplished chemist, and has given special attention to that difficult branch of organic chemistry which is concerned with bodies of the class to which the antitoxins belong.

"In a paper published in 1897 Ehrlich advanced his 'side-chain' theory. He considers the individual cells of the body to be analogous, in a certain sense, to complex organic substances, and that they consist essentially of a central nucleus to which secondary atom-groups having distinct physiological functions are attached by 'side chains'—such as chemists represent in their attempts to illustrate the reactions which occur in the building up or pulling down of complex organic substances. The cell-equilibrium is supposed to be disturbed by injury to any of its physiological atom-groups—as by a toxin—and this disturbance results in an effort at compensatory repair during which plastic material in excess of the amount required is generated and finds its way into the blood. This Ehrlich regards as the antitoxin, which

is capable of neutralizing the particular toxin to which it owes its origin, if this is subsequently introduced into the blood. In this theory a specific combining relation is assumed to exist between various toxic substances and the secondary atom-groups of certain cellular elements of the body. The atom-groups which, in accordance with this theory, combine with the toxin of any particular disease germ, Ehrlich calls the 'toxiphoric side chain.'*

The fact that the toxin produced by the tetanus bacillus has an elective affinity for the cells of the nervous tissues seems to be well established. The wonderful toxic potency of this toxin is shown by the researches of Kitasato and by those of Brieger and Cohn (1893). According to the last-named authors the chemical reactions of the purified toxin show that it is not a true albuminous body. When injected beneath the skin of a mouse weighing fifteen grams, in the dose of 0.00000005 gram, it caused its death, and one-fifth of this amount gave rise to tetanic symptoms. The lethal dose for a man weighing seventy kilograms is estimated by Brieger and Cohn to be 0.00023 gram (0.23 milligram). Comparing this with the most deadly vegetable alkaloids known, it is nearly six hundred times as potent as atropin and one hundred and fifty times as potent as strychnin. Ehrlich's explanation of the origin of antitoxins is opposed by Buchner and others. According to Buchner the antitoxins are to be regarded not as reactive products developed in the body of the immune animal, but as modified, changed and *'entgiftete'* products of the specific bacterial cells. He insists that they do not neutralize toxins by direct contact, but only through the medium of the living organism.

On the other hand, Ehrlich insists that the antitoxin neutralizes the toxin directly, in a chemical way, and that such neutralization occurs when they are mixed in a test-tube, even more effectually than when they are injected separately into the body of a susceptible animal. The experimental evidence appears to me to be in favor of Ehrlich's view, but neither time nor space will permit me to present this evidence or to review the experimental data upon which Ehrlich bases his side-chain theory. The reader is referred to Professor Aschoff's work for a full discussion of the subject. Certainly Ehrlich's views are entitled to great consideration, but it is evident that his theory, however plausible it may appear, especially to chemists, is far from being established upon a reliable experimental basis. For us, the numerous facts which have been brought to light by his painstaking researches have a far greater scientific value than his 'Seitenkettentheorie.'

GEO. M. STERNBERG.

* Quoted from the writer's 'Text-book of Bacteriology,' second edition, 1891.

DISCUSSION AND CORRESPONDENCE.

SOME MATTERS OF FACT OVERLOOKED BY PROFESSOR WILSON.

PROFESSOR WILSON seems to think that the general scientific public is in danger of getting 'a wrong impression' of the situation at Wood's Holl from my article in SCIENCE of October 3; and in order to prevent this he offers some criticisms and insinuations which, I think, may produce a worse impression than the one he desires to correct. Let me say, therefore, to begin with, that our different standpoints and opinions have been, and will doubtless continue to be held on perfectly friendly terms.

Professor Wilson has favored merging the laboratory in the Carnegie Institution, and he has insisted very strongly that the independence of the laboratory would not be thereby endangered in any essential respect. This view was naturally seductive, for what friend of the laboratory would not welcome a permanent support which could be had without the sacrifice of a single principle or condition of vital importance? The financial difficulties under which we have so long labored predisposed all to accept relief and forget the risk. The assurance that there was no real risk from the one who had carried on most of the negotiations for our side, and the conditions proposed by the Carnegie committee all tended to allay doubt. Our organization was to remain essentially as

it is, our work was not to be interfered with, we were to direct the policy of the laboratory as hitherto, and our needs in the way of land, buildings, boats, libraries, etc., were to be provided for; in short, we were to have a permanent laboratory with staff and equipment for work throughout the year, a laboratory that would rival the best in the world. So bright did the prospect appear to Professor Wilson that he could speak of it as '*beyond the dream of avarice.*' With all my faith in Dr. Wilson's sagacity, I cannot escape the suspicion that he has been under the spell of some trance-like illusion, which, for the time being, excludes a calm consideration of 'matters of fact.'

If the latest communication from the Carnegie committee does not dispel the illusion, I do not know what will. This communication has gone to all our trustees and will probably be announced at the proper time. It is sufficient to say, that it conclusively confirms the position I have taken, namely, that the laboratory should remain forever independent, but always ready for cooperation and always grateful for such support as its work may deserve.

This is the main point of my paper, which Professor Wilson criticises in a spirit that seems to me to fall a little short of amiable; but I hope I am mistaken in this.

As the matter now turns, we may rejoice that our trust and our mistakes have not been confounded by the Carnegie trustees; and we are most deeply indebted to their wisdom, frankness and generosity. It is now, I believe, needless to follow Professor Wilson further on this point, as he has been answered by the communication above mentioned more effectively than by any arguments that I could offer.

There is just one incident bearing on this point, which I wish to recall as a significant matter of fact. After our corporation meeting, August 12, a petition was drawn up by one of the members and presented to Professor Wilson for approval. That part of the petition which concerns us here was as follows: 'We, therefore, hope that the trustees of the Carnegie Institution may find it possible to support the Marine Biological Laboratory in the manner proposed, *without requiring it to become a branch of the Carnegie Institution.*' Professor Wilson read the petition, and at once declared that he was willing to sign it. When the petition was presented a few days later, Professor Wilson, for reasons that need not be given here, declined to give his signature, and the petition was consequently abandoned. The incident is significant as showing that at that time Professor Wilson was willing to endorse a preference for preserving the independence of the laboratory. I believe every member of the corporation would have been glad to sign such a petition, had it seemed safe and proper to do so. The fact throws light on the situation as a whole, and as it is no secret, I feel justified in bringing it forward.

I regret that Professor Wilson does not seem to approve of the publication of my paper in Science. I felt that the time had come for me to remove the misunderstanding in regard to my position. I stated the situation as I understood it, and frankly avowed my desire to preserve the independence of the laboratory. I submitted the paper to a number of the trustees and finally to Dr. Billings, who consented to its publication. Professor Wilson stigmatizes my view as 'pessimistic' and closes with a reference to past criticisms of the laboratory which might well have been omitted as wholly unprovoked and uncalled for. This is the most unkind cut of all, that a friend of the laboratory should thus covertly countenance its calumniators.

One point more. Professor Wilson objects to my saying that the plan of acquiring the laboratory as a condition to supporting it did not originate with the trustees of the Carnegie Institution. I stated the matter as I understood it and as I still see it. Professor Wilson was not the only one on our side who at first had a hand in determining events.

We have been repeatedly told by the Carnegie committee that they should have preferred to recommend support without ownership, and one of them distinctly stated in Professor Wilson's presence that it was the '*emergency*' *placed before them* which led them to the proposition finally made to us. It is little to the point to refer to the official

correspondence, for there were preliminary discussions. We all know who formulated the proposition, and I have authority which no one will dispute for saying that its author did not originate the plan, but simply formulated it as the result of the preliminary discussions between the members of our and of their special committee.

I can not, and *have not,* asserted that Professor Wilson originated the plan; but I think it safe to say that he knew of the plan before it was presented, that he approved it, presented it, and opposed the alternative plan of support without ownership, which was the preference of the Carnegie trustees. By all this Professor Wilson made himself its godfather.

In the passage quoted by Professor Wilson, the statement is made that 'they were asked on what terms they would consent to own and support it.' 'No such question,' says Professor Wilson, 'was asked or suggested in any of the official correspondence.' I did not pretend to give exact words, nor did I assert that the question occurred in the official correspondence. It is a mistake however to say that this correspondence did not suggest it. It did suggest it to me, and I think my statement fairly summarizes the attitude assumed on our side.

If Professor Wilson asked or suggested support that involved '*an obvious necessity*' of ownership by the Carnegie Institution, and if he has never objected to such ownership, but has objected to support that did not involve ownership, the objection to my words cannot be very serious.

C. O. WHITMAN.

CHICAGO, October 14.

THE MARINE BIOLOGICAL LABORATORY AND THE CARNEGIE INSTITUTION.

TO THE EDITOR OF SCIENCE: In your article in SCIENCE, September 19, 1902, on the 'Carnegie Institution,' you make statements in regard to this laboratory on which I beg to comment. You say that 'the corporation of the Marine Biological Laboratory is a corporation composed chiefly of those who have carried on research in the laboratory.'

Pardon me if I express doubt as to the exactness of this statement. The corporation has three hundred and fifty-two members. Of these sixty-five are residents of Boston or its vicinity, and most of them are personally known to me. Very few of them have ever carried on research in this laboratory. They have aided the laboratory by donations, but not by work. I think a large per cent. of those who have carried on research in this laboratory are members of the American Society of Naturalists. A comparison of the lists of members of that society and of the corporation shows that but seventy-one (about twenty per cent.) of the corporation belong to the society; further, that the society has but half a dozen female members, while one hundred and seventeen (about twenty-four per cent.) of the corporation are women. Still further, over fifty per cent. of the corporation give no university or college address, but simply town, street and number. Persons holding university or college positions generally give their official addresses. All these facts tend to confirm me in the opinion that the corporation is not 'composed chiefly of those who have carried on research in the laboratory.'

In the past several attempts have been made to secure to this laboratory large financial support, but on every occasion we have been told by those to whom appeals have been made, that the defects in our business organizations were deterrent to those who might otherwise contribute. We were told that before acquiring endowment, land and permanent buildings, all property should be vested in a smaller and more select body. What our advisers have told us in the past, the executive committee of the Carnegie Institution has but repeated. The matter of support by the Carnegie Institution was considered at two largely attended trustees' meetings, and it was voted unanimously to recommend to the corporation that on a promise of support by the Carnegie Institution, the corporation should convey its property to that institution.

At the annual meeting of the corporation, August 12, 1902, a deed conveying the property was read, and a motion was made in-

structing and empowering the treasurer to so convey the property.

You moved that the following amendment be appended to the motion: 'That the corporation of the Marine Biological Laboratory request the trustees of the Carnegie Institution to consider the possibility of assisting the laboratory without making it a branch of the Carnegie Institution.' A large majority voted against this amendment. It was made a second time in a slightly altered form, but received still less support.

The original motion was then put before the meeting, and by an overwhelming majority it was

Voted: That the Treasurer, D. Blakely Hoar, be and he is hereby authorized and instructed to execute, acknowledge, and deliver, in the name and behalf of this corporation, the deed which has just been read, conveying to the said Carnegie Institution, all and singular, the properties of this corporation, and also any and all other documents of title in the opinion of counsel necessary or expedient fully to vest the title to such property in said Institution.

You and two others cast the only opposing votes. Yet, in your article in Science you state that 'It was the preference of nearly all the members of the corporation that the laboratory should be assisted by the Carnegie Institution without being made a branch of it.' I do not know on what this statement can be based.

In another part of the same article you say, 'the director and other scientific men serve the laboratory without salary.' The director, yes. The other scientific men, no. All members of the staff who need or wish it receive remuneration for services rendered.

In 1901 the salaries of the scientific staff amounted to $2,625. The income was $8,448.22, so that the salaries were about thirty per cent. of the income. In 1902, the salaries were $3,700. This, of course, does not include the curator, collector, janitors, boatmen, etc. These are the figures given by the treasurer.

Before the annual meeting of the corporation, the question was freely discussed, whether teaching would be continued under Carnegie Institution control, and how that would affect the numerous small salaries now paid.

It is to the credit of these men who receive salaries that when they were called on to consider the advancement of the laboratory, they forgot their salaries and helped to form the great majority in favor of Carnegie Institution control.

Edw. G. Gardiner,
Secretary.

Marine Biological Laboratory,
Woods Hole, Mass.

I trust that Dr. Gardiner will permit me to reply briefly to his remarks:

1. I am not correctly quoted in his first paragraph, as may be seen by reference to my article (p. 461 above). Instead of saying that the members of the corporation are 'chiefly' those who have carried on research in the laboratory, it would have been more accurate if I had said that 'the chief members of the corporation' or 'nearly all those who attend meetings of the corporation' have carried on research in the laboratory. The inexactness appears to be rather slight.

2. I think I was correct in stating that 'It was the preference of nearly all the members of the corporation that the laboratory should be assisted by the Carnegie Institution without being made a branch of it.' The members have never been permitted to make known their real preference. Professor Whitman, the director, and Professor Wilson, the chairman of the executive committee, who both voted for the transfer, have stated in Science that (to quote the latter) 'An organization similar to the existing one would be preferable if compatible with adequate financial support.' If Dr. Gardiner had quoted the second as well as the first half of my sentence, it seems to me that the matter would have been sufficiently explained. I continued 'but the alternative was placed before them of giving away the laboratory or losing the large support of the Carnegie Institution and perhaps witnessing the establishment of a rival laboratory.'

3. My statement that 'the director and other scientific men serve the laboratory without salary' is correct. Dr. Gardiner and I myself are among the many scientific men who have so served the laboratory. Dr. Gardiner has given a large part of his time to it for many years. Should the Marine Biological Labora-

tory become a branch of the Carnegie Institution and should Dr. Gardiner be retained as secretary, he should receive a salary.

Dr. Gardiner sends his letter to the 'Editor of Science,' but addresses me personally. The editor of SCIENCE, as representing the policy of the journal, is responsible for the acceptance of my article for publication, but not for the opinions expressed in it.

J. MCKEEN CATTELL.

COLUMBIA UNIVERSITY.

ORANGE COUNTY MASTODONS.

MR. GORDON will, I trust, pardon me for saying that he is mistaken in supposing that the bones of the last three mastodons discovered in Orange County were found in their proper relative positions. The Schaeffer specimen was scattered over about thirty by fifty feet and the greater portion of three legs was never found. The Monroe specimen is sadly incomplete and there is reason to suppose that part of it is a hundred yards away from where the tusks were discovered. Finally, the entire hind legs of the otherwise fine animal at Yale have never been recovered. There is also a specimen at Vassar that I believe came from the vicinity of Newburgh, and this too is incomplete.

It is possible, however, that Mr. Gordon has reference to the Peale specimens, and these, I believe, were fairly complete. If it is to these that Mr. Gordon refers, the mistake is on my part. F. A. LUCAS.

WASHINGTON, D. C.,
October 10.

SHORTER ARTICLES.

THE BITTER ROT DISEASE OF APPLES.

ON July 10, of this year, Mr. R. A. Simpson, an agent in the employ of this laboratory, called our attention to the fact that the bitter rot spores which infected the apples in his orchard at Parkersburg, Ill., seemed to come from canker-like formations on the limbs of the apple trees. The bitter rot was first observed by him July 9. An examination of the trees on which the rot had appeared showed that in almost every instance it was possible to trace the infection to such a canker. The tracing was comparatively an easy matter, as the first lot of infected fruit usually occurs distributed in the form of a cone, with its apex towards the top of the tree. Although it seemed probable from Mr. Simpson's discovery, which was verified and extended by us several days later, both in the orchard at Parkersburg and elsewhere in Illinois and Missouri, that a causal relation existed between the cankers and the bitter rot disease of the apples, it was not thought sufficiently well proven at that time to warrant publication. Examinations of the cankers showed the presence of pycnidia containing the characteristic pale bitter rot spores, likewise of numerous spores of *Sphæropsis malorum*, of a species of *Alternaria* and spores of several other fungi. In the cultures made from numerous cankers *Glœosporium fructigenum* appeared in every instance.*

At first conidia borne free on short hyphal branches appeared in the pure cultures, and later on the pink masses of spores usually found on diseased fruits. When kept for some time, the fungus in these pure cultures produced perfect perithecia and asci. Mycelium which produces perithecia and asci when transferred to fresh apple agar, will continue forming perithecia, the latter appearing in such fresh cultures seven to eight days after the transfer. Inoculations were made into the bark of healthy apple trees about the middle of July, with spores from pure cultures obtained from the cankers. At the same time apples were inoculated with these same spores. In the course of a week the infected apples showed every sign of the bitter rot disease as found out of doors. Inoculations were likewise made with *Glœosporium* spores taken from apples recently attacked in the orchard, both into healthy apples and into growing apple branches, at the Missouri Botanical Garden. Inoculations into the branches were made by making shallow cuts through the bark, and inserting a needle point covered with spores into the cut. Control cuts were made for every inoculation, distant but two to three inches from the infected cut. At first little difference was noticeable between

* Most of the cultures were made by Mr. Geo. G. Hedgcock, assistant in pathology.

infected cuts and the control cuts. After a week or more the bark around the infected cuts turned brown and black; it gradually dried and became more or less depressed. The branches inoculated with *Glœosporium* spores from apples showed unmistakable signs of canker formation about four or five weeks after the inoculation. Small black acervuli were noticeable about the edges of the shriveled bark, which were found to be true *Glœosporium* pycnidia. Inoculations were thereupon made with spores from these cankers, into apples, and these showed the characteristic bitter rot disease a week later.

The branches inoculated with *Glœosporium* spores from pure cultures (made from cankers taken from orchards) showed the formation of exceedingly striking cankers by the beginning of September. These cankers had numerous pycnidia with mature spores, which, when inoculated into apples, produced the characteristic bitter rot disease with pycnidia. One must add that, with the very large number of inoculations made, not a single control cut or puncture showed any signs of disease.

The cycle of infections made may be recapitulated briefly, as follows:

1. Spores of *Glœosporium fructigenum* from apples affected with the bitter rot disease, inoculated into living apple branches produced an apple canker with *Glœosporium fructigenum* spores, and the latter inoculated into healthy apples produced the bitter rot disease.

2. Pure cultures of *Glœosporium fructigenum* were obtained from apple cankers in the orchard. The spores from such pure cultures, when inoculated into living apple branches, gave rise to apple cankers with pycnidia and spores of *Glœosporium fructigenum*. These spores, inoculated into apples, produced the bitter rot disease.

It appears from these preliminary studies, that there is a causal relation between apple cankers found in numerous orchards and the bitter rot disease, and that it is very probable that this fungus is capable of living both in the bark and the fruit of the apple. This fact will be an important one in assisting apple growers to combat the disease.

The details of the cultures and the observations, together with illustrations, and a discussion as to the relationship of the various stages of this fungus and its host, are to be published in full before long.

Herman von Schrenk,
Perley Spaulding.

Mississippi Valley Laboratory, Veg. Path. and Phys. Investigations, Bureau of Plant Industry, U. S. Department of Agriculture.

THE TERTIARY OF THE SABINE RIVER.

The results of Dr. Veatch's work in the Tertiary deposits along the Sabine River, as published in the 'Report of the Louisiana Geological Survey,' 1902, are of great value in clearing up the stratigraphy of that region and in showing the presence of deposits of Jackson age in the Eocene of Texas, where they had not been recognized with certainty by earlier observers.

In his correlation of these deposits with the general Texas section, on page 141, he uses Kennedy's table. In this the reference of certain east Texas materials to the Fayette and Frio beds was made entirely on account of lithological similarity and supposed stratigraphic equivalency, but subsequent work has shown that they do not belong to those horizons, but to others of much later date.

In Texas, the area occupied by the outcrop of deposits of Lower Claiborne is so immense that it has been found convenient to break it up into four substages: The Marine, Yegua, Fayette and Frio. These four substages outcrop for more than thirty miles on the Brazos river and for no less than one hundred and thirty miles on the Rio Grande. They are all fossiliferous, and the great number of fossils collected from the first three, and determined by Professor Harris, proves their Lower Claiborne age conclusively. Professor Harris also placed the Frio clays in the same stage on the basis of such fossils as we obtained in it, and we so hold it.

These beds are usually overlain directly by Neocene deposits.

Loughridge, in his report on Cotton Production in Texas (Tenth Census Report), gave a brief description of the Miocene beds as then known, and outlined the northern

boundary very correctly. In fact it is more nearly correct than some of the later ones. The beds which he refers to this period had been previously noted by Shumard, Buckley and others, and their age determined to some extent by vertebrate remains found in their upper portion. In 1894 I described these beds * as they occur in southwest Texas and, on the basis of Professor Cope's determinations, separated the Neocene into Oakville (Miocene), Lapara, Legarto and Reynosa (Pliocene). Later I traced these beds to east Texas and proved their identity with Loughridge's beds,† and thus found that the clays and sands east of the Trinity, which Kennedy has called the Fayette and Frio, are in fact Oakville and Lapara-Lagarto. The only exception to this which I now recall is the sandstone north of Corrigan, which Professor Harris first thought was Lower Claiborne, but after study of fuller collections decided to be Jackson.

Therefore the true correlation of the two sections would probably be more like this:

	Texas Section.		Sabine Section.
	Lapara-Lagarto, Oakville ?	Neocene.	Burkville beds.
	Oakville.		Grand Gulf.
Lower Claiborne.	Frio.	Eocene.	Jackson.
	Fayette.		Wanting.
	Yegua.		Wanting.
	Marine.		Cooksfield Ferry.
			Lower Claiborne.
			Wanting as such.
			Basal Lignitic.
Lignitic.	Carrizo Sands (Queen City).		
	Lignitic.		

My interpretation would be that the Sabine section shows an overlap of the Lower Claiborne on the Lignitic, entirely covering the sandy, unfossiliferous Carrizo beds, which elsewhere in Texas form so prominent a feature at the top of the Lignitic beds. Also an overlap of the Jackson on the Yegua ? (Cooksfield Ferry beds), covering both the Fayette and the Frio.

* *Journal of Geology*, Vol. II., pp. 549, etc.

† *Trans. Tex. Ac. Sc.*, 1894, pp. 23. *Trans. Am. Inst. Min. Eng.*, Vol. XXXI.

The Oakville is stratigraphically the correlative of the Grand Gulf, and it is possible that closer work in Texas may yet show that the lower portion, in which we have found no fossils as yet, is the extension of the Oligocene portion of the formation. From Harris' determination of the age of the Burkeville beds, I suspect them to be a part of the Oakville beds, as they are certainly older than any Lapara we know west of the Trinity. It will require still further field work, however, to determine its exact relation to these beds.

E. T. DUMBLE.

A NOTE ON METHODS OF ISOLATING COLON BACILLI.

IT often happens that bacteriologists wish to obtain fresh cultures of *Bacillus coli* for experimental purposes and they sometimes find that the methods of isolation in general use are unsuccessful or inconvenient. The reasons for the latter fact have not hitherto, so far as I am aware, been satisfactorily explained. In some comparative bacteriological studies made in cooperation with one of my students, Mr. William J. Mixter, I found it necessary to obtain a large number of fresh cultures of *B. coli* and soon learned that the two methods in common use, viz. (1) 'plating out' the aqueous suspension of fresh fæces in agar, litmus-lactose-agar, or gelatin, or (2) inoculating from such a suspension into dextrose broth and incubating eighteen to twenty-four hours with subsequent plate cultivation, while giving a plentiful supply of bacteria gave, for the most part, negative results as regards *B. coli*.

After considerable experimenting we finally hit upon the following method with satisfactory results. A very small portion of fresh fæces is inoculated directly into dextrose broth in the fermentation tube, and allowed to develop at 37°. At the end of from two to six hours the culture medium becomes turbid throughout and gas formation is generally proceeding rapidly. If inoculation is now made into litmus-lactose-agar plates and incubation continued at blood heat, colonies of *B. coli* develop abundantly and with great rapidity. Isolation, purification and cultural tests can then be carried on by the usual methods,

and in some cases the colonies obtained by plating on litmus-lactose-agar represent an almost pure growth of *B. coli*. If, instead of plating after the short period of growth, the original culture is allowed to develop for twenty-four, or even for eighteen, hours, *B. coli* is isolated only with much greater difficulty.

The explanation of these facts is apparently simple. In the first few hours a rapid development of colon bacilli occurs, while other microorganisms present multiply more slowly, but if a longer incubation period is allowed, the other microorganisms, especially the streptococci recently described in SCIENCE by Mr. C. E. A. Winslow and Miss Hunnewell, develop abundantly and overgrow the colon bacilli. This over-growth is probably to be explained by a study of the products of the two kinds of microorganisms. The colon bacilli produce lactic acid, but also under favorable conditions carry on putrefactive processes with the ultimate formation of alkaline matters which partially or entirely neutralize the acid formed. The streptococci flourish only in the presence of sugars, but produce abundant acid and, while, therefore, perhaps growing more slowly at the start, eventually produce much more lactic acid than does *B. coli*. Moreover, colon bacilli appear to be extremely sensitive to lactic acid of some strength and are therefore inhibited, if not actually killed, by the acid produced by the streptococci.

The method of procedure here outlined has given satisfactory results not only in the Institute laboratories, but also at the hands of other investigators than ourselves who at my request have kindly tested it.

S. C. PRESCOTT.

BIOLOGICAL LABORATORIES,
MASSACHUSETTS INSTITUTE OF TECHNOLOGY.

THE EGGS OF MOSQUITOES OF THE GENUS CULEX.

THE conventional description of the oviposition of *Culex* has been rendered obsolete by recent observations. This description was based on the eggs of *Culex pipiens* Linn., a species which deposits them in large, boat-like masses, floating on the surface of water. The eggs do not hibernate. This has been assumed to be the general manner of oviposition in the genus *Culex*, but such is not the case. So far as at present known, *Culex* pipiens is the only *Culex* that so deposits its eggs.

The species of *Culex* may be divided into two groups, the first comprising those species in which the legs are unbanded, the second those in which the tarsal joints are banded with white rings. The method of egg laying is different in these groups. In the first group, the eggs are generally laid floating on water and apparently they do not hibernate. *Culex pipiens* belongs to this group, but its boat-shaped masses of eggs represent the extreme form of development of the floating type of egg. In *Culex melanurus* Coq., the eggs are laid singly, floating on the surface of water; in *C. territans* Walk., they are laid in little groups of two or three, side by side and also floating; finally, in *C. pipiens* Linn. we have the well-known boat-shaped mass. However this type is not exclusive for the dark-legged species of *Culex*, for *C. triseriatus* Say lays its eggs singly, adhering firmly to objects at the extreme edge of the water, and the species doubtless hibernates in this state.

In the ring-legged species of *Culex*, the general type of egg described by Professor John B. Smith (SCIENCE, N. S., XV., 391, 1902) obtains. *C. sollicitans* Walk., described by Professor Smith, laid its eggs dry at the edges of places where water was likely to collect and the larvæ hatched when water appeared. *C. canadensis* Theob. lays its eggs singly and they do not float on the water, but mostly sink to the bottom. In this species the eggs will hatch in part in the presence of water, but most of them remain unhatched till the winter is passed. There seems to be a full brood of these mosquitoes early in spring from hibernated eggs, after which only scattering eggs hatch, most of them going over to the next season, whether wet or dry. In *C. sylvestris* Theob., the eggs are laid similarly and sink in water, but the species breeds continuously all the summer, practically all the eggs hatching when covered by rain water. But a set of eggs obtained in September all hibernated, although they were kept wet.

There remain many species of *Culex* whose

eggs are unknown, but it seems probable that we now know the principal types of eggs.

HARRISON G. DYAR.

U. S. NATIONAL MUSEUM,
October 1, 1902.

RECENT ZOOPALEONTOLOGY.

NEW VERTEBRATES OF THE MID-CRETACEOUS.

THE report just published on 'Vertebrata from the Mid-Cretaceous rocks of the Northwest Territory of Canada'* by Henry F. Osborn and Lawrence M. Lambe, forms the second part of a 'series of descriptive and illustrated quarto memoirs' begun in 1891. The first part, by the late Professor E. D. Cope, is on 'The Species from the Oligocene or Lower Miocene Beds of the Cypress Hills.'

The determination by the Canadian Survey of a Mid-Cretaceous and fresh-water fauna, including fishes, batrachians, reptiles and mammals, is a forward step of great importance in vertebrate paleontology. The Survey had established beyond question, geologically, that the Belly River series is Mid-Cretaceous, that it underlies the Montana or Ft. Pierre-Fox Hills group, and overlies the Ft. Benton and Dakota groups; and at the outset of the paleontological investigation for this report, the question arose, What stages of vertebrate evolution are represented by the Belly River fauna? It soon appeared to Professor Osborn in the study of the fine collection made by Mr. Lambe that the Belly River vertebrates of the Northwest Territory were of decidedly different and *apparently* of older type than those from the Laramie beds of Converse Co., Wyoming, described by Marsh, and were rather to be compared with those described by Leidy, Cope and Marsh, from Montana, chiefly from the Judith River beds, which overlie the Ft. Pierre in a region by no means distant geographically.

The Belly River or Mid-Cretaceous fauna is distinguished from that of the Upper Jurassic (Como Beds, Purbeckien) by the entire absence of Sauropoda and by the presence of Ceratopsia in great variety. It is affiliated with that of the Jurassic, and, so far as we know, separated from that of the Laramie by the presence of highly specialized Stegosauria or plated dinosaurs,* by numerous turtles of the Jurassic family Pleurosternidæ, and by numerous large Plesiosaurs. There is very little in common between the Belly River fauna and the Laramie fauna of Wyoming and Colorado so far as described, except the dinosaur *Ornithomimus* and the very persistent chelonian *Baëna*. Most of the dinosaurs will probably be found to be separated generically.

A comparison between all the Belly River and Judith River or rather Montana and Laramie (Colorado and Wyoming) vertebrates, so far as named (111 species including many synonyms), leads to the conclusion: (1) that the Belly River fauna is more ancient in character both as to the older types of animals which it contains and as to the stages of evolution among animals which are also represented in the Laramie; (2) the geological interval represented by the Ft. Pierre-Fox Hills marine beds was accompanied by the extinction of certain Jurassic types and progressive evolution of the persistent types; (3) finally, the fossil land vertebrates hitherto described from Montana probably are, in part at least, of Mid-Cretaceous or Belly River age, although the true Judith River beds certainly overlie the Ft. Pierre and are of more recent age.

The descriptive section of the memoir by Mr. Lambe is illustrated by twenty-one plates and numerous text figures. The principal results are as follows:

Numerous vertebræ of a large plesiosaur from the Belly River are provisionally referred to the New Jersey species *Cimoliasaurus*

* 'Contributions to Canadian Paleontology,' Vol. III. (4to), Pt. II., 'Vertebrata of the Mid-Cretaceous of the Northwest Territory.' (1) 'Distinctive Characters of the Mid-Cretaceous Fauna,' by Henry Fairfield Osborn, Vertebrate Paleontologist (Honorary) of the Survey; (2) 'New Genera and Species from the Belly River Series (Mid-Cretaceous),' by Lawrence M. Lambe, Assistant Paleontologist. Ottawa, September, 1902.

* The only published evidence of Stegosauria in the Laramie of Wyoming and Colorado is the tooth of *Palæoscincus*.

magnus Leidy. From Moreau River, South Dakota, Leidy has described two plesiosaurs, *Nothosaurops occiduus* and *Ischyrosaurus antiquus;* whether these animals are of Belly River age or more recent is not known.

Turtles of the suborder *Trionychia* are abundant. One species, *Trionyx foveatus,* is common to the Judith and Belly River series; another, *T. vagans,* to the Belly River and supposed 'Ft. Union' beds. The order Cryptodira is represented in the Cretaceous by large swamp turtles related to the Dermatemydidæ, but belonging to the family Adocidæ; these are *Adocus lineolatus* Cope, *A.* (*Basilemys,* or 'royal turtle,' Hay) *variolosus* and *A. (Basilemys) imbricarius;* the royal turtle is very large and elaborately sculptured. It is important to note that the two species first named are found both in the Belly River and in Montana (?'Ft. Union'), testifying to the Mid-Cretaceous age of the latter. The presence of numerous species of the Jurassic family Pleurosternidæ (order Pleurodira or Amphichelydia) is another distinctly ancient feature of this fauna; two of these, *Compsemys victus* and *C. obscurus* Leidy, are described from Montana. A third member of the same family, *Baëna hatcheri,* is noteworthy as the only species of vertebrate thus far recorded which is common to both the Belly River and Laramie. A fourth new species, *B. antiqua,* is described from the Belly River. *Polythorax missuriensis* from Montana is also referred by Hay to the Pleurosternidæ. Mr. Lambe proposes the new genus and species, *Neurankylus eximius,* a new chelydroid turtle, distinguished by a supernumerary costal.

Belonging to the rhynchocephalia, *Champsosaurus,* according to Cope is represented by five species of the Judith River, one of which, *C. annectens,* is also determined in the Belly River. As Cope has identified this genus in the basal Eocene, it is not distinctive as to age.

The sculptured tooth named *Troödon formosus* by Leidy is common to the Belly River and Judith River beds; it is uncertain whether this is a lizard or a stegosaur, probably the former. *Palæoscincus costatus* Leidy is also common to the Judith and Belly River series. A clearly distinct species is *P. asper* Lambe from the Belly River.

The species *Crocodilus humilus* of the Judith River is provisionally identified by Mr. Lambe in the Belly River. These beds also contain another Montana crocodile, *Bottosaurus perrugosus,* Cope.

Passing to the dinosaurs, as stated above, the presence of Stegosauria is an ancient characteristic. From the 'Middle Cretaceous of Wyoming,' Marsh determined the Stegosaur *Nodosaurus* ('The Dinosaurs of North America,' p. 225). Probably allied to this or to the *Polacanthus* of the English Wealden, is the remarkable new animal, *Stereocephalus tutus,* in the Belly River series, with solid skull armature and a ring of postcranial, pointed ossicles.

The carnivorous dinosaurs and the collateral families will probably be greatly elucidated by the separation of the Mid- from the Upper Cretaceous types. Among the former the genera *Deinodon* and *Aublysodon* Leidy and *Ornithomimus* Marsh, all Montana types, deserve first mention. After Marsh had substituted the name *Dryptosaurus* for the preoccupied name *Lælaps* (which Cope had employed for an Upper Cretaceous of New Jersey carnivore) it was generally supposed that all large Cretaceous carnivores should be referred to Marsh's genus. If, however, the large Judith River type, which has its counterpart in the Belly River, is older than the true Laramie type, it is in all probability generically distinct and Leidy's name *Deinodon* should be applied to it.* This name was securely founded on megalosaurian teeth, and those first mentioned in both Leidy's descriptions and first figured in his memoir on the Judith River vertebrates must be regarded as valid types irrespective of the following facts: (1) that Leidy expressed some uncertainty as to his separation of *Deinodon* from the English Jurassic genus *Megalosaurus;* (2) that he associated with the types a number of large serrate incisor teeth, truncate posteriorly, which probably belong with *Deinodon;* (3) also smaller non-serrate

* Dr. O. P. Hay (*Amer. Geologist,* XXIV., 1899, p. 346) is of the opinion that Cope was justified in rejecting the name *Deinodon.*

teeth truncate posteriorly, which certainly do not belong with *Deinodon;* (4) that he subsequently selected the two latter (2 and 3) as the types of *Aublysodon.* The Cretaceous carnivorous dinosaur of the Judith River beds should, therefore, be named *Deinodon.* Belonging to this is the type species *D. horridus* Leidy; probably also the species *D. cristatus* Cope and *D. lævifrons* Cope, from Montana. To *Dryptosaurus,* on the other hand, may well belong the large Upper Cretaceous carnivore *D. incrassatus* Cope, from the Edmonton series of Alberta.

The discovery of additional remains of *Ornithomimus* in the Belly River series, as represented by a large new species, is of great interest. Mr. Hatcher states that he found Marsh's type of this genus, consisting of a foot and a portion of a limb, on Cow Island, Missouri River, at a level which he estimates from 1,500 to 1,600 feet below the summit of the Judith River beds, and 500 to 600 feet below the level of Marsh's type of *Ceratops montanus.*

Ornithomimus altus is probably a successor of a comparatively small and lightly built dinosaur recently discovered by the American Museum parties in the Como Beds of Wyoming.* *Ornithomimus* is more progressive than its supposed ancestor, in the development of cursorial rather than prehensile phalanges in the pes, these elements having nearly lost the recurved megalosauroid structure.

One of the distinguishing features of the Belly River fauna is the great number and variety of the Iguanodonts. The separation of Mid- from Upper Cretaceous iguanodonts, will, if confirmed by closer examination and determination of geological horizons and levels, greatly increase our understanding of this most interesting group. Without professing to have made an adequate investigation, Professor Osborn is strongly of the opinion that the Cretaceous includes a number of distinct genera, representing a wide adaptive radiation and probably a number of successive phyla. The wide differences in the mode of succession, general shape and border sculpturing of the teeth, indicate profound changes which required an enormous period of time for their development. There are also indications of a separation of the Iguanodonts into light- and heavy-limbed series, smaller and larger, swifter and clumsier, of great variety in tooth structure.

In the Belly River series we find the new species *Trachodon selwyni* Lambe, an animal nearly double the size of the *Iguanodon mantelli* of the English Wealdon (Upper Jurassic). A more delicately built iguanodont *P. marginatus* Lambe resembles the less robust iguanodont *Pteropelyx grallipes* Cope, but is specifically distinct in the border sculpture of the teeth. A third new species, or even genus *P. (Didanodon) altidens* Lambe, is distinguished by exceptionally high narrow teeth.

In the order Ceratopsia, perhaps more than in any other, the resemblance between the Belly River and Montana stages and the contrast between these and the Wyoming Laramie stages, so far as known, are distinctly marked. In general the contrast in the Ceratopsia is as follows: Belly and Judith River Ceratopsia, of smaller size; nasal horns very large; small frontal or supraorbital horns; widely open supratemporal fossæ; teeth single (? *Monoclonius*) and double fanged. Laramie Upper Cretaceous, Ceratopsia, of larger size; nasal horns relatively smaller (*Triceratops*) or even vestigial; greatly developed frontal horns; supratemporal fossæ open (*Torosaurus*) or nearly closed (*Triceratops*).

Monoclonius Cope is the first name applied to a Montana ceratopsid. The apparently new species, *M. dawsoni, M. canadensis* and *M. belli,* discovered by Mr. Lambe in the Belly River series, add to the variations in the *Monoclonius* type of skull in the Mid-Cretaceous. It will be observed that all of these species are known to possess large nasal and small supraorbital horns. This stage of horn evolution *may* be contemporaneous with and independent of that in the southern Laramie dinosaurs, in which the nasal horns are invariably smaller than the frontal horns, but coupled with the smaller size and open temporal fossæ, it would appear to be more primitive. The new genus *Stegoceras,* proposed in

* It will shortly be described in a bulletin of the American Museum.

this memoir, may represent a type with small nasal horns, as in some of the Laramie Ceratopsids, such as *Sterrholophus*.

It is not at all improbable that the horned dinosaurs will prove to be diphyletic, one line with persistent open fossæ leading from *Monoclonius* to *Torosaurus*, the other leading to *Triceratops* with closed fossæ.

Of the two mammals discovered in the Belly River, *Ptilodus primævus*, judging by the condition of the grooves upon its premolars and tubercles upon its molar teeth, is undoubtedly more primitive than the Laramie plagiaulacids. H. F. O.

INSTRUCTION OFFERED IN THE FISHERY COMMISSION LABORATORY AT BERGEN.

A NOVEL departure on the part of Fishery Commission authorities is announced in Norway. The scientists of the Norwegian Board of Fisheries in Bergen have arranged for the opening of a winter school of biology to be held in the laboratory in Bergen beginning January 12, 1903, and ending April 1. The course will be offered freely to students of all countries, and there can be little doubt, judging from the rich results that the Norwegian research steamer 'Michael Sars' has been gathering, that such an opportunity for marine studies will be of the greatest value. Dr. Johan Hjort, the director of the station, will have charge of matters relating to fishes —biology, spawning habits, growth and migration—and fisheries, and in connection with this work will give instruction in the practical side of oceanic investigation on board of the 'Michael Sars.' Dr. B. Helland-Hansen is to give a course in hydrography, chemical and physical, Dr. H. H. Gran in planktology, and Dr. A. Appelloef in the zoology of invertebrates and in geographical distribution. The development of this laboratory, it may be noted, is a logical outcome of the recent work which the Norwegian investigators have been carrying on in connection with the Fishery Commission. And if it bears the fruit which such an undertaking deserves, there can be little doubt that the Norwegian station will become an important adjunct to the university training of many of the younger men, in both Europe and America. One fears, however, that a Norwegian winter will prove an unfavorable season for the popularity of this work, and we may hope that a summer course on similar lines will later be arranged. B. D.

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*THE BUREAU OF ETHNOLOGY.**

PROFESSOR W. H. HOLMES, curator for anthropology of the National Museum, was formally appointed director [the title has been altered to 'chief'] of the bureau of ethnology by S. P. Langley, secretary of the Smithsonian Institution. This announcement caused inexpressible disappointment among the associates of Professor W J McGee, ethnologist in charge of the bureau, whose appointment had been looked for daily since the death of John W. Powell, formerly director of the bureau of ethnology, on September 23. Secretary Langley said to a reporter of the *Times* that it would be more decorous for Professor Holmes or Professor McGee to speak of the installation of the new director than for him to remark upon it. Neither one of these men had anything to say more than that the less said about it the better. It is the opinion of scientists that Professor Holmes did not seek the appointment. He is interested and contented in his scientific duties at the National Museum, and so much so that he will in all likelihood continue in that office, where he has gained the reputation of being one of the foremost anthropologists in America, in addition to performing the new work which he has been selected to do. Assigning and appointing scientists in the national scientific institutions lies wholly within the discretion of the secretary of the Smithsonian Institution by virtue of its regulations and custom.

Professor McGee was informed of the secretary's choice over the telephone shortly after three o'clock in the afternoon. Secretary Langley said that he would drive to the bureau of ethnology with Professor Holmes and introduce him to Professor McGee and his little coterie of workers and friends. Depressed feelings were noticeable immediately

* From the Washington *Times*.

in the offices of the bureau of ethnology on the fifth and sixth floors of the Adams Building. This was not so because there was any ill-feeling toward Professor Holmes, but because by careful and even scientific study and treatment Professor McGee was responsible for shaping a working system in the bureau of ethnology—each man and woman being fitted in the right place—that things ran, as it were, in a spirit such as that of Barnum's happy family. Secretary Langley and Professor Holmes arrived at 3:30 o'clock. They walked into the office room formerly occupied by Professor Powell. Scientists, stenographers and colored messengers formed a semi-circle around the desk where Secretary Langley stood prepared to pay a befitting tribute to Professor Powell, and then introduced the new director. He referred with praise to the competency of Professor Powell. Professor Holmes was installed into the office. He greeted the persons in the bureau, inviting them to become better acquainted with the National Museum. He was welcomed in his new place in behalf of the employees of the bureau in a brief address by Professor McGee. After Professor Holmes shook hands with every person in the room Secretary Langley went away. The office force then left the room one by one and tears were in the eyes of nearly every person who witnessed the unusual ceremonies. Professor Holmes and Professor McGee, who are the closest friends professionally and personally, remained in the director's room for a consultation and left the building together, both more or less affected by what had taken place.

Professor Holmes began his scientific career in 1889, when he entered the illustration division of the United States Geological Survey. He is a water color painter, having won highly valued medals in District exhibits. While painting in the Geological Survey he equipped himself for an office in the archeological department and in 1892 he became an ethnologist in the bureau of ethnology. He resigned this place afterward to accept a responsible office in the Columbian Museum at Chicago. About seven years ago he was offered the head curatorship in the National Museum and came to Washington to fulfill the appointment that he has since held. Professor Holmes has published various papers of scientific importance, and his discoveries and investigations of aboriginal pottery have contributed much enlightenment to the study of the habitat of groups of American Indian tribes.

SCIENTIFIC NOTES AND NEWS.

DR. W. H. WELCH, of the Johns Hopkins University, is attending the International Congress on Tuberculosis at Berlin.

WE learn from the *Botanical Gazette* that Mr. M. J. C. Willis, of the Royal Botanic Gardens at Peradeniya, Ceylon, proposes to make a tour through England, the United States and Japan for the purpose of studying agricultural and botanical institutions.

THE Liverpool School of Tropical Medicine has sent an expedition to inquire into the health conditions of the Gold Coast. Dr. Logan Taylor is in charge of the expedition.

DR. EDWARD PALMER, of the U. S. Department of Agriculture, is now in Mexico, making collections illustrating the economic botany of that country.

THE British government has appointed Mr. W. F. King, chief astronomer, a commissioner to mark the forty-ninth parallel from the Rocky Mountains to the Pacific Coast. Mr. Otto H. Tittmann, superintendent of the United States Coast and Geodetic Survey, has been appointed by the United States as commissioner for the same purpose.

A COMMEMORATIVE tablet has been placed on the house at Favières in which Professor A. A. Liébeault was born. It states that he opened a new era in the medical sciences by his discovery of the systematic application of suggestion and induced sleep in the treatment of disease. The tablet was unveiled in the presence of Professor Liébeault on his seventy-ninth birthday.

Nature states that at the opening ceremony of the new session of the Royal College of Science, held in the lecture theater of the Victoria and Albert Museum on October 2, the Huxley gold medal was for the first time

awarded to Mr. J. E. S. Moore, associate of the college, in recognition of work which he has already carried through and is still continuing in the Huxley Research Laboratory, in connection with his investigations into the African lake fauna and his studies in cytology and nuclear metamorphosis, commenced at the Naples Zoological Station. The medal is intended as an award for research carried out in the Huxley Laboratory in some branch of natural science in which Huxley was distinguished. The recipient has the option of a silver-gilt medal, and the award is in either case accompanied by the balance of the interest on the capital sum invested for the purchase of books, instruments or as an aid to research.

At a recent meeting of the Geographical Society of Christiania, at which Captain Sverdrup and other members of his recent expedition were entertained, it was announced that the Grand Cross of the Order of St. Olaf had been conferred upon Captain Sverdrup, that the Fram medal in gold was to be bestowed upon Peter Henriksen, and that the other members of the expedition were to receive the same in silver.

Mr. J. Allen Howe has been appointed curator and librarian of the Museum of Practical Geology in succession to Mr. F. W. Rudler, who has retired.

Dr. William Riddick Whitehead, author of many works on medicine and surgery, died at Denver on October 13, aged seventy years. He established the departments of medicine in the University of Colorado and the University of Denver.

Chief Engineer Henry Schuyler Ross, U. S. N., retired, died in Lugano, Italy, on October 13.

Dr. Adolfo Targioni-Tozzetti, emeritus professor of comparative anatomy at Florence, died at Careggi, on September 18, aged seventy-nine.

Dr. Alexander W. M. van Hasselt, for many years president of the Dutch Entomological Society, one of the oldest medical officers of the Dutch Army, has died in Amsterdam, aged eighty-eight years.

Dr. Rudolf Finkener, professor of chemistry in the School of Mines at Berlin, died on September 14, aged sixty-eight years.

The Harpwell Laboratory was open during the past summer from June 14 until September 12. Seventeen persons availed themselves of the facilities afforded. Considerable attention was devoted to the surface fauna and some of the forms collected prove interesting. Among them are a Copelate tunicate allied to Appendicularia, but with separate sexes, individuals with eggs and sperm being taken one evening. An actinotrocha differing considerably from that of more southern waters appeared on several evenings in small numbers. During a few evenings *Mitraria* was very abundant and on three nights large numbers of the small pteropod, *Spirialis gouldii,* were found. Later in the season (September) the young of some gymnosomatous pteropod (possibly *Clione*) were common. *Polygordius,* in all stages, was abundant, while the young of various annelids were present in great variety and enormous numbers. A few *Tomopteris,* one with ripe eggs, were taken late in the season, but these were smaller than those found farther down the coast. The whole season was very late. Echinoderm larvæ were very few and, except in the case of the sand dollar, *Echinarachnius,* attempts at artificial impregnation were unsuccessful.

It is reported that by the sale of a building at the corner of Madison Avenue and Forty-second Street to Dr. Andrew H. Smith and Davison H. Smith for $250,000, another portion has been added to the site on which the Rockefeller Institute for Medical Research is to be erected.

It is reported that M. Robert Lebaudy, the French traveler, has sent the vice-rector of the University of Paris $1,600 to maintain two students at the University of Chicago for a year.

Dr. Sven Hedin, the Asiatic explorer, has presented his zoological, botanical and geological collections to the University of Stockholm.

The German government has presented the official reports of the German Deep Sea Expe-

dition in the ship *Valdivia* to the Scottish National Antarctic Expedition. The expedition has also been presented by the Belgian government with the official reports of the Belgian Antarctic Expedition.

THE Twentieth Congress of the American Ornithologists' Union will convene in Washington, D. C., on Monday, November 17, at 8 o'clock P.M. The evening session will be devoted to the election of officers and members and the transaction of other routine business. The meetings, open to the public and devoted to the reading and discussion of scientific papers, will be held in the United States National Museum, beginning on Tuesday, November 18, at 11 A.M., and continuing for three days.

WE learn from the London *Times* that the government of India is about to form a board of scientific advice, comprising the heads of the meteorological, geological, botanical, forest, survey, agricultural, and veterinary departments, and other scientific officers of special attainments. This board is to prepare every year a general program of research, and a report describing what has been done. The main object of the scheme is to promote the economic development of the country. The resolution mentions the various scientific officers appointed in recent years, and says that the development of machinery in the different departments has rendered more essential than ever the coordination of scientific inquiry. Experiments and investigations of a similar or cognate character are being independently carried on—chemistry, economic entomology, and economic botany are given as examples—and this should be prevented. Further, it is expected that the board will check a natural tendency on the part of the government scientific officers to give the claims of abstract science precedence over the demands of economic or applied science, which are of more practical importance. The Indian government, it is pointed out, owns the largest landed estate in the world, and the prosperity of the country is mainly dependent upon agriculture; hence practical research is the predominant consideration. The board will also act as advisers to the government.

AN account of the operations carried out during the first season by the French expedition for the re-measurement of an arc of the meridian in Ecuador was lately communicated to the Paris Geographical Society by M. Bourgeois, head of the survey party, whose paper is printed in *La Géographie*. According to an abstract in the *Geographical Journal* the mission reached Guayaquil in June of last year, and the difficult task then commenced of transporting the whole impedimenta of the expedition, weighing in all some ten tons, by the primitive mule-paths which still form, for the greater part of the distance, the only means of communication between the coast and the elevated 'Inter-Andine' region, in which the operations were to be carried on. Here the first place visited was Riobamba, where, during a stay of three months, the primary work of measuring a base-line and carrying out determinations of latitude, longitude and azimuth was satisfactorily accomplished. The base-line chosen measured some 6 miles, and such was the precision with which the measurement was effected that the two separate results differed only by 7 mm., or a quarter of an inch. When this had been done, the expedition divided, one part continuing the triangulation in the neighborhood of Riobamba, while the other measured a subsidiary base north of Quito, and determined the latitude of the northern extremity of the arc; the same being done for the southern extremity by an officer despatched for that purpose to Peru. During the stay at Tulcan, the northern station on the Columbian frontier, violent earthquake shocks were experienced, the whole region having been the scene of more than ordinary manifestations of volcanic activity during the last year. Eruptions both of Cotocachi, which had been regarded as extinct, and of Cumbal, in the Colombian territory, were observed. Although nominally Catholics, the Indians of the Inter-Andine region are very superstitious, and viewed the operations of the mission with great distrust, which they even manifested by acts of vandalism. During M. Bourgeois's absence the operations have been actively prosecuted under the direction of Captain Maurain.

UNIVERSITY AND EDUCATIONAL NEWS.

It is said that Yale University will receive about $171,000 as the residuary legatee of the estate of Edward Wells Southworth.

The jubilee of Sydney University was celebrated on October 1. Chancellor MacLaurin presided, and addresses of congratulation were presented from British, colonial, and foreign universities. Professor Tucker, of Melbourne, delivered an address on behalf of the Australian universities, and Professor Baldwin Spencer spoke for the English universities.

The fourth annual conference of the Association of American Universities will be held at Columbia University on December 29, 30, and 31. The preliminary program includes the presentation of papers and reports on 'The Certificate Method of Admission to Colleges and Universities (a) from Accredited Schools and (b) from Schools not Examined by the Admitting University or Formally Accredited'; 'Uniformity of University Statistics (a) of Enrolment and (b) of Expenditures'; 'The Report of the Executive Committee on Membership,' and 'The Requirements for Admission to Professional Schools.'

Gen. Alexander Stewart Webb has resigned the presidency of the College of the City of New York which he has held since 1869.

The Rev. Edward A. Pace, Ph.D., has been appointed director of the Institute of Pedagogy which the Catholic University of Washington has established in New York City. The Rev. Thomas E. Shields, Ph.D., of St. Paul, has been appointed instructor of physiological psychology in the Catholic University of Washington, filling the place vacant by Professor Pace's removal to New York.

Dr. Francis L. Patton, formerly president of Princeton University, has been elected president of the Princeton Theological Seminary.

Dr. Henry A. Perkins has been elected professor of physics in Trinity College.

Dr. Addinell Hewson, demonstrator of anatomy in Jefferson Medical College, Philadelphia, has been promoted to an assistant professorship.

The following appointments have recently been made in the medical school of the University of Pennsylvania: Dr. J. L. Gates, assistant demonstrator of pathology; Dr. Hidaya Noguchi, assistant in pathology; and Dr. John T. Carpenter, Jr., instructor in ophthalmology.

Mr. De Pencier, B.Sc., has been appointed to a newly established assistant professorship of mining in McGill University.

Mr. C. F. Myers Ward, professor of physiology at University College, Sheffield, has been appointed lecturer in physiology in the Charing Cross Hospital Medical School, in succession to Mr. Benjamin Moore, who has recently been elected to the newly-established chair of biological chemistry in the University College, Liverpool.

In consequence of the removal of Mr. Gilchrist, the head of the agricultural department at Reading College, to a similar position at Newcastle College, the department has been reorganized, and, after a series of sittings, the executive on Saturday made the following appointments: To be lecturer in agricultural botany and director of the agricultural department, Mr. John Percival, vice-principal of the South-Eastern Agricultural College at Wye; to be lecturer in the practice of agriculture, Mr. J. O. Peet; to be lecturer in dairy farming and dairy bacteriology, Mr. C. W. Walker-Tisdale; to be director of the horticultural department, Mr. Frederick Keeble, lecturer in botany at University College, Reading; to be lecturer in horticulture and keeper of the gardens, Mr. William H. Patterson.

Dr. E. Cohen, of Amsterdam, has been called to the professorship of inorganic and physical chemistry at Utrecht.

Dr. Hermann Klein has been appointed professor of astronomy at the University of Cologne.

Dr. Eugen Dubois has been called to the professorship of paleontology in the University of Amsterdam.